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MANUAL TRAINING.

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IN EDUCATION

BY

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PREFACE.

In the preparation of these pages I have been troubled by abundance of material. Three years ago I wrote a book entitled, *The Manual Training School: Its Aims, Methods, and Results*, in which I set forth with minuteness of detail and fulness of illustration the manual features of a manual training school. I also discussed quite fully the necessity for their introduction, and their economic and educational value. I had expected to draw largely from that book in preparing a volume for English readers. In this I have been disappointed. During three years the subject has grown astonishingly. It has not only spread into every important city in America, but it has been the subject of earnest discussion in all lands. Friends and foes have appeared in vast numbers, and every phase and bearing of manual training has been closely examined. I have found it impossible to ignore the developments of these three years. The interest has centred on new points, and I have been forced to write a book almost entirely new. In it I have brought the discussion down to date. I have reduced the amount of practical details to a minimum, and I have discussed more fully the strictly educational bearings of manual work. The recent reports

of the United States Bureau of Education contain such full and satisfactory statements of the progress of manual education, that I have omitted entirely the historical element.

In England, no less than in America, I am happy to believe, the progress of the last few years has been distinctly marked. The distinguished services of such men as Sir George Whitworth, Mr. William Mather, M.P., Sir Philip Magnus, Sir Henry Roscoe, and Sir Lyon Playfair, in public life; seconded by such educators as Professors Thompson and Huxley, of London; Professor Ripper, of Sheffield; Professor Dixon, of Glasgow, and Professor Reynolds, of Manchester, endorsed by certain Journals of Education of great influence, have been crowned with a large measure of success. If this book in any way helps on the cause of rational, wholesome education, a cause which has come to be very dear to me, I shall be abundantly satisfied. Ever since I attended the Education Conference in Manchester, in April 1885, the people of England and English educators have had a very warm place in my heart. I trust it may appear from this volume that my interest in the most vital of living questions—that of the education of the coming men—is no less warm and no less fraternal now than then.

C. M. WOODWARD.

ST. LOUIS, MO., U.S.A.,
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MANUAL TRAINING.

CHAPTER I.

THE DEFECTIVE NATURE OF THE TRADITIONAL CURRICULUM BEYOND THE PRIMARY GRADES.

IT appears necessary, before setting forth the nature and positive value of manual training in a scheme of general education, to point out the defective character of the prevailing system. I shall therefore at the outset of this book specify some of the failures and deficiencies of existing schools.

This preliminary task is not an agreeable one. It is never pleasant to find fault, and it is doubly unpleasant when the faults exist in an institution dear to one's heart by a thousand tender associations, and enshrined in a deep feeling of loyalty and gratitude. Moreover, one's motive in offering criticisms is liable to be misunderstood. It matters little if one commends many features, provided he sees one that is faulty and dares to say so, or discovers one defect and dares to point it out; he is in danger of having his praise ignored and his blame held up to scorn as though it were the result of hostility or prejudice. Every critic of the existing educational

system is liable to be classed with its enemies. "The subject of the Educational Value of Manual Training has come to be, of prime importance by reason of (among other reasons) the fact that as a cause it serves to unite not only the critics of the educational system already existing, but also its uncompromising enemies."[1] Nevertheless, this ill-fortune shall not deter me.

The logical bearing of the advocacy of the new educational feature is fully recognised by those who strongly oppose it. Dr. William T. Harris, in the report just mentioned in the footnote, said that the assumption that manual training is educational in the same sense as the branches of science and literature heretofore taught, unsettles the entire question of course of study, in so far as it rests on the doctrine of a specific educational value for each of the branches in the course of study, and in so far as it is supposed that the present list of branches provides for an all-sided intellectual training. If there is such a "doctrine," and that "doctrine" fixes, not only the exact elements that enter into an adequate, all-sided, intellectual training, but just the specific branches of study which, and which alone, can furnish particular elements of that training, then I suppose the assumption, or rather, as I prefer to say, the *fact* does unsettle the question of the course of study, and I am very glad that it does so.

It may be well to reflect a moment upon this assumption of a "doctrine" which settles the question

1. Nashville Report of Committee on Pedagogics, 1889.

of the course of study for all time. Aristotle settled the question of the constitution of matter for over a thousand years, and no rational progress either in medicine or chemistry was possible till the falsity of his "doctrine" was shown. Countless questions in religion, science, and government, which some people fondly supposed had been settled over and over again, have been unsettled as often as progress was to be made. The present age is one of progress along all lines. Is it strange that some of us who are devoted to the cause of educational progress should insist upon unsettling the question of course of study sufficiently, not to destroy or mutilate it, but to improve it?

The art of education is, or should ever be, progressive. With every new phase in civilisation has come a new phase in education. The history of education, from the Centaur who trained Achilles and the Argonauts, down to the Manual Training School, is full of records of conflicts between the Old and the New. The Old has been justified by all the past with its traditions and authorities. The New has fought for recognition as the demand of the age, as essential to the progress which education ought to make, if it is kept abreast the other institutions of civilisation. Educational progress has been first the effect of progress, and then the cause of more progress. It must here suffice if I refer the reader to his history. I speak of it only to say that the present state of affairs in educational matters is in no essential particular unlike what it has been

hundreds of times in the past, when education was undergoing a decided step in its process of evolution.

The programme of progress of evolution has always been, first, a gradual recognition of the fact that the methods, appliances, and conduct of education were falling behind; second, criticisms, protests, and denunciations for failures and defects; third, suggestions of what should be added, what subtracted, what modified, what incorporated; fourth, experiments on new lines, generally failures, sometimes successes, always instructive; finally, the incorporation of new features, and the elimination of old ones.

The present age is one of rapid progress in every field. Never was there a century or a half-century so progressive. The story of our industrial, scientific, and commercial progress under the leadership of Watt, Fulton, the Stephensons, Franklin, Morse, Ericsson, Bessemer, Siemens, Edison, and others, is almost threadbare, yet I doubt if we half realise it ourselves. There is to-day scarcely an occupation among us which has not been transformed, or actually created, since the year 1800. Think of the way we build, furnish, warm and light our houses; how we cultivate our fields, and harvest our crops; how we travel, and transport goods over land and sea; how we make our clothes, our tools, our books; how we tell the news; how we make war; how we govern; and how we make peace. To be sure, the world is full of Rip Van Winkles who persist that the change is seldom progress, and lament that the "good old days" can never come again.

In spite of many improvements, our methods of education have changed least of all, unless it be in our Art, which is nothing if it is not old. In the main it is well to be conservative in education. All that glitters is not gold, and all that offers is not fruitful nor wholesome. The nature of mind is unchanged, and the laws by which intellectual, moral, and physical powers are developed, and faculties are acquired, are essentially the same in all ages. On one hand the ends of education are the same now as they have always been. On the other hand they are new, and the new aims demand new appliances. The new aims point to the new duties, the new functions, the new responsibilities which demand a measure of definite preparation on the part of youth. The system of education which is to develop a maximum of intellectual vigour is also to produce practical power; to open the doors into the world of to-day, and to give the best preparation for taking up the world's work successfully. Dr. Samuel Johnson thought that "education was needful to the embellishments of life." Said he, "Those authors are to be read at schools that supply most axioms of prudence, most principles of moral truth, and most materials for conversation; and those purposes are best served by poets, orators, and historians." It is here that our schools have been and are most deficient. They at first failed to recognise legitimate claims of the useful branches, and then having to a certain extent recognised those claims, they refuse still to recognise

the best means for meeting them. In other words, the schools persisted in ignoring or decrying the value and necessity for scientific and industrial training as compared with an almost exclusively literary culture; and secondly, having in some degree admitted that value, they persistently refuse to adopt the means whereby that scientific and industrial training may be most efficiently secured.

There is in this statement of mine no denial of the pre-eminent value of intellectual training irrespective of the subsequent value of a familiarity with the means by which that training is gained. If the mind could be disciplined only through the instrumentality of some far-off and no longer used literature, science, or art, it would then be our patent duty to resort to it, so important is such discipline. But if it can be shown that not only mental discipline, but useful practical skill, immediately applicable to the affairs of life, can be simultaneously secured, then it must clearly be our duty to secure them both. I have no great amount of sympathy with those who oppose the introduction of the useful into school education. In the first place, these decriers of all useful branches are generally extremely inconsistent. While asserting that it is a great wrong to the student to "intrude the instruments and the spirit of money-getting into his educational life" (by which they mean manual training), they are evidently entirely willing to teach the science of wealth, the details of banking, exchange, stock-buying and selling, and speech-making, the

high art of political demagogues. The educational world has yet to accept the statement of Dr. Wayland, the accomplished scholar and college president, to wit:—"It is the intention of the all-wise Creator that all intellectual culture shall issue to knowledge that is of the greatest intrinsic value; and that all useful knowledge, properly acquired, tends equally to intellectual development."

Let us now take up in order the steps I have indicated as necessary to a move forward in education.

The first step was *Criticism;* friendly, candid, searching criticism. The witnesses I shall call cannot be impeached. They are educators, scholars, men of affairs, philanthropists. The prevailing systems of education in England and America are much more nearly alike than perhaps would be supposed. I shall freely use the words and observations of critics on either side of the Atlantic, whose judgments cannot be called in question either on the ground of unfriendliness or unfamiliarity. No one of them is an enemy of public education; on the contrary, they are all strong advocates of broad generous, high education.

Professor John D. Runkle, late president of the Massachusetts Institute of Technology, says: "Public Education should touch practical life in a larger number of points; it should better fit all for that sphere in life in which they are destined to find their highest happiness and well-being. It is not meant by this that our education should be lowered

mentally, but that it should be based, if possible, upon those elements which may serve the double purpose of a mental culture and discipline and a development of the capacity of the individual with and through the acquisition of artistic tastes and manual skill in the graphic and mechanic arts which most largely apply in our industries. The student who completes his high school course at eighteen seldom willingly enters the shop as an apprentice with the intention of becoming a skilled mechanic and earning a livelihood by manual labour. His twelve or fourteen years of mental school-work, whether successful or not, have, through habit, if in no other way, unfitted him for all manual work, even if he has not in many ways been taught to despise such labour."

Mr. H. K. Oliver, of Salem, Mass., recently said: "Our system (of education) trains boys not to become better craftsmen, but to be unwilling to be put to any kind of craft. Such ought not to be the effect of education, understood in its relation to our people. But a very small proportion can be of the so-called learned professions, and most of us must be of the productive, toiling class; and while the mind should be justly cultivated that the future workman may be able to read understandingly, to think wisely, and to express his thoughts well, to keep his business records, to apply his knowledge of the science of form, and to be guided by the forms of Christian morality, the main business of his coming life should receive at least some degree of attention. . . . The

actual influence of our method of education is to make our youth in reality revolt from manual labour; they shrink from entering upon lives wherein physical labour is to be their means of living."

An eminent and successful teacher, Miss Anna C. Garlin, says in appeal for a new education:—"Let the child be taken to school whole, instead of in parts; let him be considered to have a body as well as a mind; let him be trained physically towards use, by a wise shaping of the eager animal activity; let him be protected from the cupidity of the manufacturer and the pressure of home poverty by utilising the active energy which in more primitive times was of so much account in the family economy; let him be gradually introduced into that hard world of work for which he is destined by a training which shall be of the hands as well as of the brain. . . . If we are to protect the children of the very poor from the very worst consequences of their condition without making paupers of them or their parents, we must continue (after the training of the kindergarten) in some way to give them study and work together."

State-Superintendent Wickersham of Pennsylvania said in a recent report: "It is not enough to instruct a boy in the branches of learning usually taught in our common schools and there leave him. It must be seen by some authority that he is allowed a chance to prepare himself to earn a livelihood. It takes more than a mere knowledge of books to make a useful member of society and a good citizen. The present product of our schools seems to be, in too

great a degree, clerks, book-keepers, salesmen, agents, office-seekers, and office-holders. We must so modify our system of instruction as to send out instead large classes of young people fitted for trades, for business, and *willing and able to work.*"

The finished scholar, orator, and philanthropist, Wendell Phillips, said: "The discrimination against those who prefer to work with their hands is very unjust. Our system of education helps the literary class to an unfair extent when compared with what it affords to those who choose some mechanical pursuit. Our system stops too short; and as a justice to boys and girls, as well as to society, it should see to it that those whose life is to become one of manual labour should be better trained for it."

The eminent Shakespearian critic, Dr. H. N. Hudson, is perhaps too sweeping in his criticism, but he adds a suggestion of value:—"So long as people proceed upon the notion that their children's main business in this world is to shine and not to work, and that the school has it in special charge to fit them out on all points, just so long they will continue to expect and to demand of the school that which the school cannot give. . . .

"It is *desirable* that children should learn to think, but it is *indispensable* that they should learn to work; and I believe it is possible for a large, perhaps the larger, portion of them to be so educated as to find pleasure in both. But the great question is, *how to render the desirable thing and the indispensable thing mutually helpful and supplementary.* For surely the

two parts of education—the education of the mind, and the education of the hand,—though quite distinct in idea, and separate in act, are not, or need not be, at all antagonistic."

"In these days of repeating rifles, Harvard sent me and my classmates out into the strife equipped with shields and swords and javelins," said Charles Francis Adams, jun., in his remarkable Phi Beta Kappa address.

"We cannot continue in this age full of modern artillery to turn out our boys to do battle in it, equipped only with the sword and shield of the ancient gladiator," says Professor Huxley, using the same striking figure.

Sir Lyon Playfair changes the metaphor, but is none the less expressive. What he protests against is not literary study, but the exclusion of those modern subjects which bear directly upon the duties and responsibilities of life. He says, "In a scientific and keenly competitive age, an exclusive education in the dead languages is a perplexing anomaly. The flowers of literature should be cultivated and gathered, though it is not wise to send men into our fields of industry to gather the harvest, when they have been taught only to cull the poppies, and to push aside the wheat."[1]

Professor Ripper, the Director of the Sheffield Technical School, speaking of the striking inadequacy of present school education, which recognises the close relation between school-work and many occupations which are likely to follow, declares that

[1] British Association Address, 1885.

"there is at present no sort of connection between the school-room and the workshop; between the training and the future employment of boys. Work, workshops, tools, materials, or workshop problems are never mentioned in the school; they have no place there; all reference to these things is excluded as a sort of necessary evil which it will be time enough for the children to deal with when they are obliged. But the present grinding, aimless system of mere book-learning and cram is not destined to live much longer in its present form."

One is reminded of the state of mind of the good Mrs. Rouncewell in *Bleak House* when she discovered in her second son a disposition to construct "steam engines out of sauce-pans, and to invent apparatus whereby his canary could pump water for his bath. She, poor soul, with a mother's anguish, felt it to be a move in the Wat Tyler direction, well knowing that Sir Leicester Dedlock (from whom she always took her cue) had that general impression of an aptitude for any art to which smoke and a tall chimney might be considered essential."

But in spite of his mother's gloomy foreboding, and Sir Leicester's violent prejudices, the lad "shew no sign of grace as he got older, but, on the contrary, constructed the model of a power loom, etc."[1]

[1] "If Sir Leicester ever saw him when he came to Chesney Wold to visit his mother, or ever thought of him afterward, it is certain that he only regarded him as one of a body of some odd thousand conspirators, swarthy and grim, who were in the habit of turning out by torchlight, two or three nights in the week, for unlawful purposes."

There are plenty of Sir Leicesters and Mrs. Rouncewells still living and still looking with strong disapprobation upon every educational feature which would recognise as wholesome any such aptitudes, not to speak of fostering and encouraging them. A city school superintendent said at a convention in Washington, in March 1889, that those useful features of education whereby one is directly helped to earn his bread, and to provide a home for his family, may safely be left to "a number of pressing necessities which will drive men up to" a proper training in them.

Education for use (it is argued) may therefore be left to itself; it is only the education that is not for use in the struggle for bread-winning and home-making that must be provided for by the State in the common schools.[1]

[1] Superintendent Frederick M. Campbell, of Oakland, Cal., said: "The education of the hand can be left to the individual; the education of the mind must be secured, beyond all peradventure, by the State. Mark the essential difference; the necessity of getting a living forces itself upon every man, for his own immediate selfish interest. The necessity of educating his children has no such visible urgency upon the ignorant man; that is, for the interest of others, rather than for his own selfish interest; and the consequences, even to them, are too remote and far-reaching to his dull mind. No doubt the State would be better off for having an abundance of skilled artisans, but intelligent men it *must* have."

It is not worth while to more than point out two fallacies in that argument. The writer has given a reason for "compulsory education," and yet he appears to think he has shown that the industrial education of the children may safely be left to the father, or to the hard circumstances of their life, while their book education cannot be so left. Secondly, he assumes that if industrial features should be

Superintendent Dutton of New Haven, Conn., says "we are brought face to face with the serious fact that social and industrial progress has outstripped education and left it far behind. The education of the three R's, or even the most varied and complete culture now furnished by the schools, will not give those habits of acute perception, clear judgment, and manual dexterity essential to the greatest usefulness in industrial life. Our graduates have not even an elementary knowledge of materials and processes." Elsewhere the same educator says: "It may be admitted that during one period in the history of schools, it was permitted to teach anything but what was immediately useful." To this he hopefully adds, "That time has passed. It is now conceded that if the useful arts can be taught so systematically as to train and discipline the highest powers of mind and character, there is no sound reason for neglecting them." I would gladly believe that so much is conceded by educators, but I fear that such concession is far from general. In most cases the school deliberately steers away from matters directly useful to labouring people in order that, as they say, "the spirit and instruments of money-getting may not be

incorporated into education by the State, and some of the school children should grow up and become artisans, they would fail to be *intelligent* men.

This is closely following the lead of some eminent English writer who urges us to "teach the beautiful—the useful will take care of itself." It is probable that Herbert Spencer was fully justified in his remark that the education which has made England what she is to-day has "got itself taught in nooks and corners."

intruded into one's educational life." Every item of practical knowledge, every step in industrial skill, is supposed to be base and mercenary in motive and influence. There is a strong disinclination to give a boy a chance to fall in love with mechanics, and to so perfect him in his daily work that he shall be not only willing but eager to continue a mechanic and make his future promotion dependent upon his success in the industrial field.

I remember once hearing of a man by the name of William Gray who had achieved a position of wealth, influence, and usefulness in the city of Boston. On one occasion he reproved a workman for poor work. Smarting under deserved censure, the man retorted, "Well, you needn't put on airs to me! I can remember when you were only 'Billy Gray, the Fiddler.'" "Very true," replied Mr. Gray, "I was a fiddler, but did I not fiddle *well?* I got on because I did my work well, whatever it was; and now I am able to tell whether you do your work well or not."

I fancy that there is really no more of the mercenary spirit in aiming at a high standard of excellence in tool work, and in putting into it all available art and science, than there is in making zealous and thorough preparation for the business of a teacher, a journalist, or a physician.

Nevertheless, if a boy looks forward to being a lawyer, every one gladly urges him to study this and that because it will directly help him in his profession. But suppose he says he hopes to be a mechanic or a farmer; instead of urging him to make

a thorough study of the science and art of wood working, drafting, forging, or agriculture, in order to become a superior pattern-maker, or smith, or farmer, he is generally told to study something else which bears only remotely, if at all, on his chosen career, in the conscious hope that he may be cured of his fancy or whim, and finally give up his idea altogether and follow something more genteel and cheerful than mechanism and husbandry.

Note how Mr. Adams, quoted above, speaks of his college training:—"As a training-place for youth to enable them to engage to advantage in the actual struggle of life, to fit them to hold their own in it and to carry off the prizes, I must, in all honesty, say that, looking back through the years and recalling the requirements and methods of the ancient institution, I am unable to speak of it with respect. Such training as I got, useful for the struggle, I got after instead of before graduation, and it came hard. While I have never been able, and now, no matter how long I may live, I never shall be able, to overcome some great disadvantages which the superstitions and wrong theories and worse practices of my Alma Mater inflicted upon me. . . .

"The college fitted us for this active, bustling, hard-hitting, many-tongued world, caring nothing for authority and little for the past, but full of its living thought and living issues, in dealing with which there was no man who did not stand in pressing and constant need of every possible preparation as respects knowledge, exactitude, and thoroughness—the poor

old college prepared us to play our parts in this world by compelling us, directly and indirectly, to devote the best part of our school lives to acquiring a confessedly superficial knowledge of two dead languages. I shall hold that I was not myself sacrificed wholly in vain if what I have said here may contribute to so shaping the policy of Harvard that it will not much longer use its prodigious influence toward indirectly closing for its students, as it closed for me, the avenues to modern life and living thought."[1]

Sir Philip Magnus says that "people often talk and write as if school time should be utilised for teaching those things which a child is not likely to care to learn in after-life, whereas the real aim of school education should be to prepare, as far as possible, for the whole work of life. It is because the opposite theory has so long prevailed that our school training has proved so inadequate a preparation for the real work of life."

As I write the above I recall an incident of two days ago. A widow came to consult with me about the education of her two boys, aged fifteen and sixteen years respectively. By her own labour in the counting-room of a business house she had maintained them at a classical school till, in spite of all the advice and authority of the educators thereof, she had broken away and come to me. Her boys, she said, were accustomed to spend the entire morning of every day on the Latin and Greek languages; after

[1] Harvard is less deserving of this criticism to-day. See what President Eliot says, pp. 24, 25.

noon they had Greek history and pure mathematics. In two or three years they both must go to work, earning not only their own support but their mother's as well. The boys were only of average ability, and as they looked forward to the coming responsibility they had felt strongly the unfitness of their schooling, and had begged for some change. It was only after a long struggle that the mother sufficiently overcame the scholastic influence to apply to the manual training school. One of the boys entered that school yesterday. The case is one of many, and well illustrates the drift of popular educational endeavour.

I am reminded of the severe strictures of Canon Farrar on the unfruitfulness of English classical schools. They who differ have no reason to decry him nor to explain away his words on the ground of prejudice. I can assign no reason for supposing that he does not speak the honest truth as it had revealed itself to him. In a lecture delivered before the Royal Institution of Great Britain, Canon Farrar, the distinguished author and philologist, a master of Harrow, and for thirteen years a classical teacher, thus avows "his deliberate opinion, arrived at in the teeth of the strongest possible bias and prejudice in the opposite direction, arrived at with the fullest possible knowledge of every single argument which may be urged on the other side":—"I must avow my distinct conviction that our present system of exclusively classical education, as a whole, and carried on as we do carry it on, is a deplorable failure. I say it knowing that the words are strong words, but not

without having considered them well. I say it because that system has been 'weighed in the balance and found wanting.' It is no epigram, but a simple fact, to say that classical education neglects all the powers of some minds, and some of the powers of all minds." He regrets especially the "deadening" effect on the sensibilities of burdening the memory with unmeaning and useless words.

Professor Thomas Eggleton, the eminent scientist of Columbia College, New York, says:—"There is no longer room for doubt that in the old system of education, where the reasoning powers were trained by abstract mental processes alone, without the aid of the eye and the hand, and the brain was crammed with facts, the application of principles to the circumstances of everyday life was rendered difficult. This was because the pupil was not taught how to make such application, nor did he see any use made of the principles he was acquiring. They were to him only theories, and consequently the retention of facts was a mere matter of memory without interest. As for the principles which underlay them, they were in many cases either misapplied because they were not understood, or were forgotten altogether."

If one scans closely the programme of actual school work for pupils of all ages, he finds it chiefly literary. The pupil of fourteen or sixteen years is found studying Greek, Roman, and domestic history; Latin, orations and poems; grammar, Greek, French, or German; modern literature, chiefly poetry; rhetoric and English composition; mathematics; and a little

science from a book. One is impressed with its highly literary character.

Now when I claim, and when others claim, that such a programme is faulty, it is not to be understood that we fail to duly appreciate the classics, or history, or poetry, or modern languages. The above programme was mine as a pupil, and for years mine as a teacher. I know something of the enthusiasm with which both pupil and teacher may prosecute such studies. My criticisms therefore do not spring from a lack of knowledge of what is doing in schools, nor from a lack of sympathy with the greater part of the work itself. I know how pure, how generous, how delightful, and how satisfying all this may be. What can be finer than to take the children of the people and lead them along these paths? What can more ennoble, more inspire good thoughts and chaste ambitions?

Yet when I lift my eyes from my books and study life, the life that is, the activities that make up the civilisation of to-day, the responsibilities that must soon fall upon the shoulders of my pupils, the demands that to-morrow will put upon them—I am brought face to face with the solemn fact that we have ignored the actual demands of our own age and trained them for an ideal age wherein they are to live exempt from all problems of labour, manufacture, construction, transportation, invention, and domestic economy.

Ruskin once said that the education of a gentleman was chiefly the classics and English History; but he gave to the term "gentleman" a narrow meaning.

He was not thinking of the three hundred thousand boys of school age in London.

Sir Philip Magnus said in his Report to the Education Conference in 1884: "A literary training is not the best preparation for the pursuits in which a large proportion of the population are now engaged. . . . This (literary) training is the survival of a method well enough adapted at one time to those who alone received education—*i.e.*, the English gentry and the nobility—but unintentionally extended to the other classes, who, on account of the difference of their pursuits, require a totally different system of education."

Similarly, President Walker says that it is little less than a shame that the American high schools, the crowning glory of the system of free public education, "should graduate pupils highly accomplished in languages, composition, and declamation, but weak in perception, practical judgment, manual dexterity, and executive faculty; who have been trained in description without having been taught to observe the things they should describe; who have spent years in the art of rhetorical elaboration and ornamentation without acquiring any adequate body and substance upon which to exercise those arts; who are great at second-hand knowledge, but confused and diffident when thrown upon their own resources; skilful with the pen, but using any other tool awkwardly and ignorantly."

William Mather, M.P., declares that in spite of educational progress the traditional character of

teaching remains, and that it furnishes but a one-aided training. "Memory, rather than the whole mind is appealed to; names, dates, events, grammar, rhetoric, and literature engage an unreasonable share of the school time." He, too, asserts the comparative inutility of so much exclusively literary culture. "It is of secondary importance, after reading and writing have been acquired to serve as useful instruments, to pursue systematically the study of grammar, language, and literature, analysis of sentences, refinement of composition, elegance of expression, and remote historical events."

When Mr. Mather asserts that "the present methods of teaching do not meet the wants of the nation, or do justice to the children who are compelled to attend our public elementary schools," he utters the thought which every student of social science must share.

Professor Edmund J. James, of the University of Pennsylvania, is a student of social science and a close observer of schools and teaching. He refers to public education when he says: "When we take a broad view of the curriculum as a whole, we must acknowledge that it is very one-sided. The schools cannot be successfully defended from the charge that their effort is chiefly, if not altogether, devoted to training one side of the child—one set of activities to the exclusion or neglect of the rest. It must confess, after all, that so far from being the purely liberal school of which its defenders boast so much, it is largely professional in character, preparing almost as directly

and immediately for certain definite callings as if it were a trade school pure and simple. In other words, our public schools at present—and let us not be confused here by any cry about liberal training—are in a sense professional schools for such callings as book-keepers, copying clerk, selling clerk, etc., where brightness and ability to write a fair hand or add a column of figures are the *only* necessary qualities. The inevitable result is that such callings are continually overcrowded." In respect to the incompleteness of the school curriculum, the United States and England are much alike, and observing Englishmen are pointing out the same faults that we see. Professor Huxley sympathises greatly in the new movement. Of course he knows well what the old education has accomplished, but he is not blind to its defects. He says: "The old method has the effect of being too bookish and of being too little practical. The child is brought too little into contact with actual facts and things, and as the system stands at present it constitutes next to no education of those particular faculties which are of the utmost importance to industrial life. I mean the faculty of working accurately, of dealing with things instead of words."

One of the greatest evils in all communities lies in the early withdrawal of pupils from school. In America, where the law does not compel attendance at school as a general thing, the great majority of boys leave school before they are twelve years old. In England there is a very general withdrawal as soon as the point required by law is reached. There is, I

suspect, a very wrong impression as to the causes of such withdrawal in America. Poverty is occasionally the cause; sometimes it is stupidity, no doubt. The usual explanation is: a mercenary spirit, a desire to earn money, as compared with the supposed non-mercenary spirit of those who remain in school. This probably does great injustice to this class of boys. The fact is, the boys who withdraw do not take a lively interest in the work of the schools; the extravagant amount of memory work does not attract nor inspire; they are generally poor spellers and poor penmen; they have poor memories for words, and are slow of speech. Such boys stand a poor show for positions as clerks where a glib tongue and good hand-writing are essential to success. Hence the motive of those who leave school is precisely the same as that of those who remain—namely, that they may secure a kind of training that is to be to their ultimate advantage. The unsatisfactory, unattractive nature of the curriculum is well pointed out by President Eliot of Harvard University, while discussing the possibility of enriching the programmes of lower schools.

"As a rule the American programmes do not seem to be substantial enough; from the first year in the primary school onward there is not meat enough in the diet. They do not bring the child forward fast enough to maintain his interest and induce him to put forth his strength. Frequent complaint is made of overpressure in the public schools, but it is not work which causes overfatigue so much as lack of

interest and lack of conscious progress. The sense that, work as he may, he is not accomplishing anything will wear upon the stoutest adult, much more than upon a child. One hour of work in which he can take no intelligent interest will wear him out more than two hours of work in which he cannot help being interested. Now the trouble with much of the work in the public schools is that it is profoundly and inevitably uninteresting to the childish mind. The best way to diminish strain is to increase interest, attractiveness, and the sense of achievement and growth."

That is a very discriminating statement, and it bears with great force upon the secondary schools where the pupils first become conscious of tastes, likes and dislikes, in different studies. Being undisciplined, they are largely controlled by their interest or their lack of it.

President Eliot might have added that not only do the schools in a measure fail with such as remain pupils, on account of their "profoundly and inevitably uninteresting work," but it is this unattractive work which drives the great majority away. The children ask for bread: the schools offer them stones, and the children turn away.

This language seems harsh, but it is just. *Not one boy in fifty goes through the high school,* though it is free, and in many cities even text-books are furnished. No more conclusive evidence can be imagined to prove that the curriculum of secondary schools is unpopular. Forty-nine boys withdraw to one who

goes through. Why do they withdraw? It would be well if we knew just why in any large city, though reasons would vary in different places. But we know enough of boys, and programmes, and family necessities to enable us to approximate to the truth. One school superintendent, evidently a teacher of experience, says: "It is a matter of fact that 75% of 'third-reader boys' drop out of school before they reach the next round. It is not the children of the abject poor alone, but of the well-to-do parents also. By far the greater number of absentees stay at home because they or their parents lack that interest which would insure prompt attention."

Suppose we make our estimates as follows:—

Of those who leave school—

Five per cent. are withdrawn by illness and death	.05
Ten per cent. are driven away by poverty..........	.10
Ten per cent. are deficient in brain power..........	.10
Ten per cent. are vicious, will neither study nor work, but shun school and all decent society.	.10
Ten per cent. are put to work by cruel and selfish parents or guardians who want their wages...	.10
Ten per cent. withdraw to go to private schools...	.10
Forty-five per cent. withdraw because they find school dull, tiresome, and unprofitable. To them it offers neither the stimulus of a strong interest nor the promise of adequate reward, in the way of valuable preparation for the work of life, as compared with the sort of apprenticeship a lad may serve in mercantile or manufacturing establishments................	.45
	100%

I have no hesitation in saying that with well-organised and free public manual training schools

more than *one-half* of this withdrawal could be prevented. See Chapter XI.

As an instance of secondary schools, take the public high schools for boys in the city of Boston. It has two kinds of high schools for boys—I. The Latin School,[1] which prescribes for its pupils a classical course with particular reference to their probable future occupations in the so-called learned professions. It is probable that few boys enter the Latin School who do not expect to go to college. And it is generally thought that if a boy does not go to college he has wasted his time in the Latin School. II. The English High School, which was established in 1821. Its young men go mostly into mercantile life. The English High School chooses particular subjects for its course of instruction, with an eye to the wants of the majority of its pupils whose pursuits in after-life are to be mercantile or commercial.

Such are Boston's two high schools for boys, both necessary and excellent, as I have every reason to believe. The city may well cherish them with pride. But where is its third high school, which shall impart a culture as truly liberal as that given by either of the others, but which shall at the same time select studies and exercises with the fact in view that most of its pupils will be looking forward to occupations in which an experimental acquaintance with the mechanical arts will be either highly serviceable or

[1] The Boston Latin School was established in 1635. "It prepares boys for college. Thence they go out to follow the professions of divinity, law, and medicine."—School Document No. 15, 1883.

absolutely indispensable? The number of pupils who would naturally and properly seek the training of such a school is probably far greater than that seeking both the others combined; yet as such a school does not exist in Boston, all its possible pupils drop out of the grammar grades and disappear from the school records. Then (marvellous instance of poor logic!) the wiseacres declare that it is folly to talk of spending money to provide school facilities for those who do not stay in school long enough to take advantage of them![1]

I am happy to be able to say that the city of Boston is likely soon to extricate itself from its illogical position. The School Committee have resolved to establish the third High School—that of Manual Training — on the same plan as the English High School. I have little doubt that before my words are in print the work will be in progress.[2]

I am well aware that many educators, and even many communities, do not deserve the above criticism. I should be sorry to appear to criticise any

[1] See the paper by Superintendent E. P. Seaver, of Boston, on "Mechanic Arts High Schools," in Circular No. 2, 1889. Bureau of Education, Washington.

[2] See Appendix for the greater part of the Report of Superintendent Seaver. This admirable report, on which the action of the Boston School Board was based, is recommended to all students of this subject. Its value arises from the fact that Mr. Seaver took time and trouble to visit and study thoroughly all the prominent schools of Manual Training in the United States, and adopted his plans after careful comparison. It is of course very gratifying to the writer to find that, with some few modifications, the plan and details of his own School have been adopted by Superintendent Seaver.

one unjustly, or to repeat old criticisms upon a condition of things which has passed away. Just as in prehistoric times different tribes and races progressed at widely different rates of speed—some virtually standing still while others rose through all the stages of savagery and barbarism into civilisation; so in different communities the spirit of educational progress varies greatly in force. Educational leaders have wide followings, whether conservative or progressive. A strong superintendent often determines the tendency of his constituency. He, like Lincoln, both leads and is led. He creates and obeys public opinion.

School Boards composed of educated men are apt to have ideas of their own, and the superintendent often takes his cue from them. As a rule School Boards, composed as they are of business men with much shrewdness and little sentiment, are less conservative than school teachers. The latter have records which require consistency, and have accomplishments which are not to be discounted by new and unfamiliar standards. The former have learned to discard methods and ideas which the time has outgrown, and they would reconstruct a school and its course of study as readily as they would use a stenographer, put in electric lights, use a triple expansion engine, or build a monitor. Just as Cambridge and Oxford are the most conservative forces in England, so the hundreds of classical colleges, and their feeders, the literary high schools, are the strongholds of our conservative educational

forces. They do not represent public opinion at all; they are far behind it. The representatives of such institutions do not read the records of manual training, nor do they visit manual training schools to see what they are, and to observe their methods and results. They are too often ready to "pooh-pooh" the whole matter, and try to put it behind them by calling it a "craze" or a "fetesh," that will soon be forgotten. But truth and justice require me to say that many of our best men are with us in this movement for an "all-round" curriculum, and I gladly see the number rapidly increasing; and again, the opposition of others arises in most cases from prejudice and a false assumption in regard to the aim and influence of manual training. They assume that the aim is to teach trades and to neglect literary and scientific culture almost wholly. Even when they do not make these false assumptions they have a groundless fear that the influence of tool-instruction and a measure of practical work will have a tendency to degrade scholarship and corrupt the pupils' minds and hearts. Such being the case, time only is necessary to bring about the conversion of every fair-minded opponent.

The reader will observe that I do not for one moment admit that the assumptions of our opponents may be correct, and that their prejudice may rest on a good foundation. I know that we are exposed to grave dangers; I know that weak and injudicious friends are often more dangerous than open enemies; I know how often the wish is the father of the thought,

and that indiscreet enthusiasts will try with pupils of eight years to anticipate the work suitable for those of fourteen years. But I have no fears for manual training under the care of discreet and competent teachers.

To name all those prominent educators who, on general principles and without personal experience in connection with manual training, have still accepted our criticisms and endorsed our methods for improving the schools, would be quite impossible, and it must suffice if I name one, and quote his conclusions. Henry Sabin, Esq., is the superintendent of public schools of the great State of Iowa. I quote the following vigorous paragraphs from his Report for 1889:—

"Industrial education does not, as I understand it, mean a lessening of intellectual vigour. There is no design of lowering in any degree the standard of scholarship. It is in no way associated with learning a trade or serving an apprenticeship. Industrial education does not of necessity fit the child for the industrial pursuits of after-life, although no harm could ensue if it did. Perhaps I may qualify that remark. Industrial education should fit the child, not for any particular industrial work, but for any work to which, in the emergencies of life, he may be forced to turn his attention.

"It should expand and increase his resources, and give him confidence in himself. It should arouse and strengthen the manly instincts and powers of the man.

"We are told that knowledge is power; but knowledge is not always power. There are men who are for ever learning, yet never really know anything. Men who count themselves wise, who dig deep into the mysteries of things, and yet the world sets them upon the dunce-block, puts the fool's cap upon their heads, and makes fun of them. The intrinsic value of knowledge is always on the productive side. Change the adage so that it may read, *Applied knowledge is power*, and we have at once the key to our present civilisation and progress. This is just what we hope may be accomplished by industrial education. Its advantages do not contemplate the narrow purpose of teaching the child a trade, but the broader purpose of enabling him to act as well as speak; to do as well as think; not with the idea of giving him something to do, but to give him the idea of doing something. So that when he leaves school, whether he becomes a blacksmith's apprentice, or a clerk behind the counter, or enters an office, he may be able to bend all the energies of head, heart, and hand to making himself perfect in his calling.

"Industrial education, as far as it seeks to give skill to hand and eye, concerns itself as much with the probabilities as with the possibilities of life. It fits the child to work at the forge and the bench, to plough and reap and weave, just as much as it does to sit in the editor's chair, or to fill a position of emolument or power. It does not seek to impress upon the child the dignity of labour, but the dignity

of manhood. A sound heart which throbs for God and humanity is a good thing; a sound heart and a clear, strong head is better; but a sound heart, a clear head, and a skilled hand give us the nearest approach to a perfect man."

I must not forget that primarily I am speaking to an English audience, and that the educational problem in Great Britain is somewhat different from that in America. Education is on different planes. The great public schools, like Eton and Rugby, still feed the Universities. Changes are slowly creeping into them, and into the Universities themselves. But it is not with them that I am now dealing. The Primary Education Act of 1870 for the first time undertook the great work of providing ample school facilities for all the children of the land. Though the duty was long neglected, the Government took hold of the work with a strong hand. It was determined not only that there should be adequate school-rooms, but that the children should be compelled to enter them. A year ago Mr. Mather reported that while it was estimated that there were five millions of children between the ages of five and fourteen, the accommodation for all ages amounted to five and a half millions. Thus the nation has school-houses for all its school children. It is now pertinent to ask what is the character and efficiency of its schools? I visited both Board and voluntary schools in London and Manchester in 1885, and yet I do not feel competent to speak decidedly of their character. It would appear from such testimony as I have been

able to gather that the teaching has been along old lines for the most part, and that the appliances have been almost exclusively books. Of course a magnificent work has been accomplished. I fancy that it is practically impossible to find a person in his teens who cannot read and cipher.[1] But because much has been done we must not suppose that all has been done.

I know of no better authority as to the results of popular education than Mr. William Mather, M.P., already quoted. I am happy to refer often to his admirable addresses and reports. He is no unfriendly critic, but a strong and earnest friend of popular education. I quote as follows from his address before the British Association in 1887:—

"My experience has been sufficient to convince me that the method of teaching in our Public Elementary Schools, admirable as it is in giving a higher tone to our working classes, and in developing considerable literary power, yet in the main is one-sided in its effect, even on a really gifted boy, while it does nothing to call forth the practical faculties in boys who, slow and even stupid in the class-room, may possess considerable aptitude in acquiring knowledge after they have begun to work for a living. Among the children of the poorest classes there must be thousands who enter into occupations entirely out of harmony with their natural endowments, owing to our present methods of teaching being too rigid, appealing only to one set of faculties in a boy instead of to the *whole* boy.

[1] This is a thing we cannot yet say in America by long odds.

"As an employer I have had opportunities of testing the qualities of the education given in our public schools by selecting boys who have passed the examinations brilliantly, and whose school record stood very high even in science subjects. In an establishment of mechanical engineering one can test above all things *intelligence*, or the faculty of using knowledge by applying it to something to be done. It has often astonished me to find the want of this faculty in boys whose memories were no doubt well stocked for examination purposes, and who could speak correctly and write grammatically, but whose constructive faculty was dormant.

"Since the passing of the Education Act of 1870 many changes and improvements have been made in the Education Code, but the traditional principle of teaching has not been reformed.

"Memory, rather than the whole mind, is appealed to; names, dates, events, grammar, rhetoric, and literature engage an unreasonable share of the school time. The natural sciences, recently introduced into our school courses in the higher grades as special subjects, still hold a secondary place in the order of studies; oral teaching and text-books, more than experimental work and illustrations, are employed in these branches, and too little time is allowed for the mental digestion and assimulation of scientific truths."

These quotations bring up the influence of the *Science and Art Department of the Government* scheme. It has been in operation but a few years, and though it has been of great value, no doubt,

it is clear to me that it has fallen far short of what should be done. Mr. Mather, in a recent address,[1] calls the existing science and art teaching "dilettante and feeble." He pointed out that the object of the Technical Instruction Act is to make possible a training incomparably superior to that hitherto given in science and art classes.

He said that "the method of instruction in both science and art is chiefly in class form, through lectures and books, illustrative diagrams, and models. Drawing of course is a manual operation; but the general outcome of these classes is that the memory is more exercised than is fair to students, and their understandings fail to grasp and incorporate the truths taught so as to make them part of their mental possessions."

How much will be accomplished under the recent Act remains to be seen. Much is possible, but I fear that little is probable. The most important improvisions are permissive instead of mandatory, and all attempts to introduce the new feature of manual training will be met by vigorous opposition on the part of certain teachers and friends of church and parochial schools.

The common elementary schools of England are not free as they are in the United States, though the fees are very small, and there are no high schools or schools of secondary grade to which pupils are regularly promoted at the age of about fourteen.

[1] Public Address on the Technical Instruction Act, Manchester, November 1889.

On the other hand, the children of the poorer classes withdraw before they are fifteen years old.

In characterising the results of the Science and Art work in English schools as "dilettante and feeble," I fancy that Mr. Mather would make an exception in favour of chemistry, in so far as it has included laboratory work. A chemical laboratory is easily furnished; the materials used are inexpensive; and the methods of instruction, experiment, and investigation have been effectually worked out. Consequently, class work in practical chemistry is more often satisfactory than in any other branch of science.

Laboratory work in physics and mechanics has generally failed on account of an utter lack, on the part of both teachers and pupils, of skill in the use of tools, and a total ignorance of the laws of construction.

CHAPTER II.

THE REMEDIES PROPOSED.

I THINK it may now be assumed, on the strength of the evidence given in my first chapter, that there is more or less of misdirection and consequent failure in the advanced grades of our common schools.

To repeat the conclusion of Canon Farrar, the traditional system of book-training which we call education neglects some of the faculties of all minds, and nearly all the faculties of some minds. The programme of studies and exercises needs to be carefully revised. On the one hand it should be pruned of worthless appendages; on the other it should be enriched by judicious additions. It needs invigorating; it must interest, attract, and inspire those whom it now tires, repels, and disheartens.

In applying a remedy we must be certain, not only of the facts as they exist, but of the causes which have led to them.

Many admit the comparative failure, yet fail to indicate the true cause. They insist that the meagreness of result is due to poor teachers, who come to their work with no special preparation, no professional zeal, and no purpose beyond the year's salary. With such teaching material (they argue) it is no wonder that poor work is done. Instead of being

astonished that pupils withdraw early, we ought to be surprised that any remain. The remedy they propose is more and better teachers' training schools, and higher standards of qualification in the examination and selection of teachers. It is pointed out that every other profession requires long and severe study and definite preliminary training; that the physician and lawyer must add a long term of special study and practice to an extensive general education before they can be allowed to assume the grave responsibility of preserving the health or protecting the rights of clients; that the engineers who provide us with systems of water supply; who build and equip our railways; who throw bridges across our rivers, cleanse our cities, light our streets; who make the brain and hand of one man count for more in the industrial life of to-day than the labour of thousands in the days when the pyramids were built or when Xerxes marched into Greece—that these engineers must be long and carefully trained in the theories that underlie the great forces of nature, and in the methods the world has discovered for rendering them of service to man, before they can be trusted to direct the spending of money for improvements in trade, travel, manufacture, or social economy. Even the people who make our garments, weave our carpets, or shoe our horses, must serve a certain apprenticeship. But they who teach our children, who attempt to direct the development of those intellectual and moral faculties which are of more worth than all mere earthly considerations,

they may be persons of small attainments, no experience of the activities for which they are preparing their pupils, no knowledge of the functions required of them, and entirely devoid of professional training.' While I have no wish to reflect unduly on those who become pedagogues with no special training in the theory and art of teaching, nor upon those to whom the advantages of higher education have been practically denied, I hasten to admit that poor teachers are responsible for no small part of the failures, and I cordially endorse the proposition that there is no longer any justification for the employment of untaught, untrained instructors. Normal schools (which, with military and naval academies, are the only professional schools with propriety maintained by public taxation) are so numerous and so well equipped that appointing powers have no valid excuse for refusing to appoint trained teachers. If the supply is inadequate, let the number and capacity of normal schools be increased.

But do not misunderstand me. While I believe that very much of the efficiency of the school depends on the teacher, and while I believe that facilities for properly training teachers should be enlarged and multiplied, I am far from admitting that that is all that need be done. In my judgment the radical defect of one-sidedness which I have pointed out cannot be cured by carrying out with more skill and completeness the one-sided programme. If the medicine prescribed is wrong, it does not help the patient to have it faithfully and zealously administered.

If the plan of a military campaign is fatally in error, it does not entirely mend matters to put its execution into the hand of a well-trained leader. If a scheme of education leaves out certain lines of development and culture, an able and enthusiastic teacher may carry his pupils along other lines so thoroughly as actually to magnify the very evils complained of. I therefore conclude that the remedy for the defects and failures is not to be found in the better training of teachers on old lines, however desirable that better training may be in itself. It appears to me that no course is open to us but that of "unsettling the entire question of course of study," and of challenging the "doctrine" that "the present list of branches studied provides for an all-sided intellectual training."[1]

This "doctrine" of the all-sufficient character of the present course of study, which we have now the temerity to "unsettle," is best stated by Dr. Harris (now Commissioner of Education) in an address before the Ohio Teachers' Association in 1888.

"There are five windows of the soul, which open out upon five great divisions of the life of man. Two of these relate to man's comprehension and conquest over nature, the realm of Time and Space. ARITHMETIC furnishes the survey of whatever has the form of time; all series and successions of individuals, all quantitative multiplicity being mastered by the

[1] Report of the Council Committee on the "Educational Value of Manual Training." Nashville, Tenn. 1889.

aid of the art of reckoning. Through the GEOGRAPHICAL window of the soul the survey extends to organic and inorganic nature. The surface of the earth, its concrete relations to man as his habitat and as the producer of his food, clothing, and shelter, and the means of intercommunication which unite the detached fragments of humanity into one grand man—all these important matters are introduced to the pupil through the study of geography, and spread out as a panorama before the second window of the soul.

"Three other departments or divisions of the human life lie before the view. Human life is revealed in the HISTORY, civil, social, and religions of peoples. The study of the history of one's native country in the elementary school opens the window of the soul which looks out upon the spectacle of the will-power of his nation.

"In the language of a people are revealed the internal logical laws or structural frame-work of its reason, and the conscious realisation of the mind of the race, as they appear in the vocabulary, grammatical laws, or syntax. GRAMMAR opens to the child this view of the inner workings of the mind of the race, and helps him in so far to a comprehension of his own spiritual self.

"LITERATURE, finally, is the most accessible, as well as the fullest and completest expression of the sentiments, opinions, and convictions of a people; of their ideals, longings, aspirations. The fifth window of the soul looks out upon this revelation of human nature through literature.

"In the high school the traditional course of study continues the lines marked out already in the elementary schools."

Arithmetic leads into algebra and geometry. Geography becomes physical, "being a compend of ethnology, zoology, botany, geology, meteorology, astronomy, physics, and chemistry. Under the last two it takes a survey of elements and forces and their quantitative manifestations." History leads into psychology. Grammar leads into more grammar and more vocabularies. Literature leads into more literature.

Such is the "doctrine." It is throughout a study of books. In so far as it deals with nature and human life and history, it assumes that they are all in books. In a "compend" one may "review" all the sciences. From the pages of a book one may learn the manifestations of force, their quality and their quantity. All the activities of life may be learned from books. The opinions, statements, and thoughts of others suffice for inspiration, culture, and directive intelligence.

I do not hesitate to challenge that doctrine. It demands only that one shall read and remember. In place of cultivating the perceptive powers by actual seeing, hearing, and feeling; it substitutes the recorded sensations of others. In the place of personal experience it substitutes empty words which we have not the training to understand. In the place of action, of execution, of invention, it substitutes inaction, passivity, and vain imaginings. In the place of accurate personal knowledge of details and relations, it sub-

stitutes vague generalisations and shadowy abstractions.

Is it to be wondered at that the product of our schools is unsatisfactory? That the work is "profoundly and inevitably uninteresting"?

To state the extravagant claims of the "doctrine" is to suggest the remedy. We need more of the concrete, less of the abstract; more of primary knowledge, less of secondary; more personal experience, less of memory. We need more life, more action, more interest, more of the executive, and less of the passive; more of growth, less of absorption.

I should be unjust to the spirit of the times and to myself, if I did not admit with pleasure the advance now making in the direction of a rational study of science. Though the advance is by no means unanimously endorsed by educators, it has the hearty approval of the great majority. But candour requires me to confess that practice falls far short of profession. Science laboratories for student work are few and far between—except on paper.

Drawing also, which was given no foothold in the "doctrine," is coming into general recognition as an important element in general education. Drawing has its two phases, artistic and scientific. In each phase it is a language, a tool of thought and a means of expression. The effort to teach drawing historically and abstractly has achieved much of success, but it has suffered from the lack of meaning incidental to all abstractions.

However, I rejoice in all that has been done in the

direction of a rational study of both science and drawing in our schools. Both should enter into the education of every child. I not only cheerfully admit so much, but I earnestly demand that both shall be rationally taught. It is a delusion to suppose that either science or drawing can accomplish the half of what they ought, unless manual training goes with or before them.

The definite remedy I propose for the evils I have pointed out in secondary schools is the introduction of manual training, and a judicious abbreviation of the time devoted to literary work. But let me put in a *caveat.* Manual training is not a panacea. It will not make good teachers out of poor ones; it will not transform all dull and bad boys into bright and good ones. It will not abolish poverty, prevent illness, make parents unselfish, nor convert every lazy, shiftless boy into an industrious, thrifty man. But some things it will do. It will generally make school work interesting and school attractive. It will furnish opportunity for personal experience, for action, for the training of the will, for the culture of the executive powers, for the development of directive power. These points will be elaborated in subsequent chapters.

The value of a branch of study in a scheme of education must be determined by considering its influence in the connection in which it is placed. One of the great functions of manual training is to throw light on the subject-matter of other branches. It is really a sort of general culture

which acts beneficially upon every other branch. Shop exercises and shop drawings more than double the value of drawing in general, of whatever kind. It puts life, meaning, and force into it, without which drawing is apt to be lifeless, meaningless, and educationally worthless. It is much the same with regard to its influence upon science study.

Take two boys of the same age (say sixteen years), the same ability and training in other respects, and let one have had manual training and the other not. Now let them take up together any of the science studies usually taught in secondary schools. Put books and manuals into their hands. Lecture to them and show them experiments. Put them in a laboratory and set them to using the apparatus already there. Give them an outfit of tools and materials and ask them to construct their own apparatus according to drawings and specifications as contained in a laboratory manual. Do any or all of those things and you will be surprised at the difference between the two boys. They will read with different eyes, form different mental pictures, put different meaning into the words and diagrams of the book. One understands as he reads, the other does not. As you lecture and experiment before them one sees the rationale of the process before the other does; one appreciates your skill or want of it; the other sees nothing of the sort. One observes minute details of drawings and apparatus which escape the notice of the other. In handling and using the apparatus one is quick,

handy, and apparently lucky in avoiding breaks and injury; the other is timid, slow, and unlucky.

One is in a measure prepared for results, and is quick to interpret phenomena; the other is wild in his suggestions and slow in his interpretations. In the construction of apparatus from original design or from given directions, one is intelligent and expert, the other is confused and helpless.

I observe that teachers of natural science are generally strong advocates of a preliminary manual training. They know how essential a knowledge of drafting and an ability to handle tools is to one who designs or constructs, or even keeps in order a piece of physical apparatus.

But perhaps after all the value of manual training to a student of the principles and applications of science lies, more than anywhere else, in his ability to read diagrams, to form correct mental pictures of matters described in words, and in his appreciation of the qualitative elements in a process requiring several successive steps.

I do not expect people to fully appreciate the last few paragraphs. Many have never acquired the ability to understand me. One can read the description of a process very glibly, yet he may be utterly innocent of any just conception of the force of the language; he may even be able to picture accurately the details of a certain form which is to be produced, say from a simple mass of steel,—yet be completely at loss as to the practical methods of seducing the given mass of steel to the exact required form.

A well-known educational writer has frequently declared that there was nothing in tool work that was not a wasteful repetition of the exercise of drawing. No statement could more perfectly illustrate the fact that persons without practical experience, cannot comprehend the lessons taught only by actual experience. In a subsequent chapter I shall point out the full meaning of a process, and I shall attempt to show how much there is in producing clearly defined objects beyond mastering the details of their geometric form.

Returning now to our programme of studies, I venture to suggest a substitute for the "doctrine" quoted.

In the place of five windows through which the soul looks out upon the worlds of nature and of man, some years since I made the statement that the course of study in a secondary school should proceed simultaneously on five parallel lines. They were: 1, Mathematics; 2, Literature; 3, Science; 4, Drawing; 5, Tools and Processes. Such a combination is broad and liberal.

My figure was drawn from an army of five corps marching on parallel roads, sweeping all before it.

I am now lead to another figure—viz., that furnished by architecture—in which the education of a man is represented by the erection of a citadel, with its circle of battlements looking out on all sides upon the vast and varied interests and activities of human life. Whether we use one figure or the other, we

must not leave one window unopened, or one route unexplored.

Every citadel is strong if attacked only on its strong side. But the cautious general examines every approach, and assaults the weakest spot. Woe to him whose circle is not complete, who has builded zealously and beyond all reason in certain points, while others are left unguarded.

When the sea-goddess Thetis took her baby-boy Achilles by the heel and dipped him in the Styx, whose contact was to render him invulnerable, she little thought that the touch of her hand was to leave the heel unguarded, and that it was there that the shaft of Paris was to find his life. Alas! how many of our weak spots are due to a defective education? How often did our teachers follow the old track, with no thought of keeping abreast of the times, or, if they thought of it, they scouted the idea that their methods could be improved, and counted it unscholarly and mercenary to study how Eads spanned the Mississippi and Baker the Frith of Forth; how London and New York are supplied with pure water; while it was taken as evidence of high scholarship and a noble spirit to be able to describe Cæsar's bridge across the Rhine, and a mark of unselfish devotion to learning to be able to describe the battle of Salamis!

They taught us the ancient and ignored the modern because they were taught so themselves, and because they were filled with the mistaken notion that to know modern science and art and thought

is sordid and commonplace, but to know ancient science and art and thought is culture. How eagerly did schoolmasters strive to make us poets and orators, or soldiers bearing swords and spears!

When we stepped out of the school-house or college into modern life we found ourselves in *terra incognita.* As a rule the people did not speak Latin, wrote no pentameters, and had no ambition to make bloody conquests with Roman legions and Macedonian phalanxes. It was a strange world: the people were following strange gods, the holy altars were deserted, the sacred fires were gone out, and men were utterly depraved. The only atmosphere that seemed natural to us was that of the school and college. No wonder we fell to teaching, and that we taught religiously what we had ourselves been taught.

At last the scales have fallen from our eyes. Some of us, if not all, are ready to exclaim, "Whereas I was blind, now I see." No longer will we admit that the test of scholarship is an accurate knowledge of a dead language as opposed to a perfect mastery of living speech. No longer is erudition to consist of a familiarity with the vagaries and speculations which once passed for science, in the presence of a fair comprehension of a single branch of modern science. No longer shall culture be confined to an intimate knowledge of family histories, and the literature of people who have vanished from off the face of the earth.

Of course all this is rank heresy and stark disloyalty. What mercy can I expect? None at the

hands of Philip drunk—I appeal to Philip sober. I lay my case, which is the case of a vast and increasing army of teachers, not one whit behind the others in zeal, devotion, and ability—I lay our case before the sober second-thought of mankind; and in the name of civilisation, in the name of a higher science, a purer literature, and a finer art yet to be, I ask for a broader culture, a more generous scholarship, a fuller recognition and a closer sympathy with all that is pure and noble and manly in our industrial life.

CHAPTER III.

THE SCOPE AND CONTENT OF MANUAL TRAINING.

Drawing and Woodwork.

THERE is something in a name, by virtue of its derivation, but not everything. Like all technical terms, the words "manual training" must be taken in a very restricted sense. A name derives its force and meaning from the *thing* it stands for. The word *locomotive* derives its meaning, not from two Latin words, but from that mighty product of human thought and skill that thunders resistlessly along its pathway of steel. The etymologists would fain claim as *manual training* all the educational work in which the hand is used. This is as uncalled for and as unreasonable as it would be to claim everything as *pedagogic* which is driven by the foot—*e.g.*, a football, or a sewing machine. However useful etymology may be in suggesting words, and hinting at the force of old ones, we cannot be said to fully understand a word till we know it so thoroughly from its use that we prefer to ignore its etymology. None but a soldier knows the full force of the words "present arms." The attractiveness of the Swedish word (slöjd) "sloyd" is that (to us) it has no etymological meaning to bias us. It shall forever mean to us just

what we see that it means when we see the *things* that the Swedes call by that name.

I therefore abandon the dictionary as affording an insufficient explanation of the meaning of "manual training." Were it possible, I would lead each of my readers through the various departments of a manual training school, and show him just what manual training is. But such an exposition is of course impossible. I shall therefore attempt, in this and subsequent Chapters, to exhibit manual training on paper. But first let me state the extent to which manual training enters into the school curriculum, and set forth the nature of the other school work which goes on simultaneously with it.

Starting with boys in their teens, I shall assume that three full hours daily are given to recitations or lessons in mathematics, science, and literature (or language)—one hour to each. The pupils are old enough to give with profit at least two hours to home study on the lessons to be recited at school. Thus five hours of home and school time daily are to be devoted to ordinary school work.

Under the head of mathematics should come in succession: algebra, geometry, higher or applied arithmetic and mensuration, some simple work on mechanics, and bookkeeping.

Under science come: physical geography, elementary zoology and botany, chemistry (mostly practical), physics (mostly laboratory work), and physiology.

Under literature should come: rhetoric (of a very practical sort); history, American and English and an

outline of general history; and some choice specimens of modern prose and poetry. In addition to this, every pupil should have some knowledge of some other than his mother-tongue. Every one is profited by the reflex influence that comes from the careful study of another language. The peculiar structure and force of English becomes much more clear after the study of French, or German, or Latin. Accordingly, opportunity for such studies (one at a time) should be offered. If the pupil proposes a course in higher education, these branches may be taken up later.

To drawing should be given an hour a day. This will enable every boy to become a good draughtsman. He will become familiar with projection, section, and detailed drawing, whether of ironwork, stonework, or woodwork. Isometric projections, intersections of geometric surfaces, developments of simple character he should understand, and he should know how to construct simple shadows. Geometrical drawing should include not only problems of the line and circle, but higher curves, such as the conic sections, the cycloid, and the helix.

He should know how to tint and shade with both pen and brush, and should have some practice in laying on colours. He should know how to trace on cloth and to sketch with pen and ink. He should have an abundance of freehand sketching preliminary to the making of instrumental drawings. There should be careful study of lettering, plain and ornamental; some practice in design and architectural drawing.

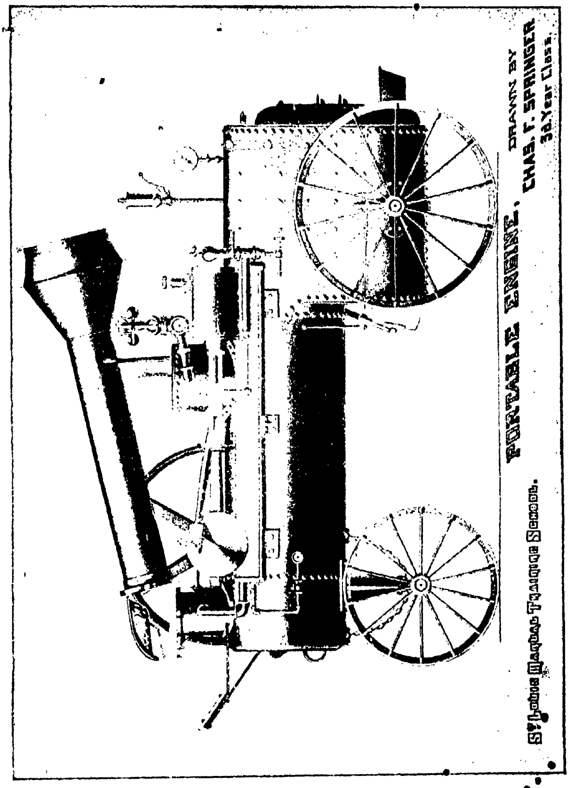


FIG. I.—SPECIMEN OF STUDENTS' DRAWING FROM ACTUAL MEASUREMENT.

It is generally well to require of each student when near the end of his course an elaborate and highly-finished drawing of some complicated object, drawn from actual measurement. A piece of machinery with its exact dimensions and geometric forms generally furnishes the best subject for this work. The character of a final drawing, which is supposed to embody nearly all that the student has learned, is best shown by an illustration. Fig. 1 is an exact reproduction on a small scale of a drawing scarcely better than the average of those executed by the students during their last term in school. The original drawing was made on a sheet of stretched paper, 19″ by 23″. Every piece of the engine and carriage was first sketched freehand in the yard where the machine was standing exposed for sale. These sketches were then taken to the school drawing-room, and from them the instrumental drawing was made. The actual dimensions of the parts were placed upon the finished sketch.

With this brief outline of the drawing usually taught in a manual training school, and the hints I give on projection drawing in another place, my readers must be content. I will only add that experience has shown that boys of fourteen to seventeen years find it easy and even delightful to do what formerly technical students who were eighteen to twenty years old found it necessary to do. Many a technical graduate has told me that the drawing our students do is fully up to the standard of much that is done in technical schools.

Be that as it may, the work of young boys has been a great and pleasant surprise to me.

The remaining feature of the daily programme is that of shopwork. It by no means always comes last in the day, but I here come last to consider it. Its usual allowance of time every day is two hours. With boys younger than fourteen it should be less; with older boys it may be more. To all it should be regular and in order. No one should be allowed to elect this and omit that; to spend time unduly in one shop and slight another. If one is already somewhat skilful, he can still take the full course with profit. "Extras" will fill his time, and perfection is hard to reach. If he is slow and dull he must still keep along with the class, even if some things are left unfinished. The shop teacher is not likely to have more trouble with him than the teachers of mathematics and literature have with dull and lazy boys.

Now as to the nature of the shop work and the motive of it. In defining it I must resort to the process of elimination in order to prevent confusion of thought. Let me make clear the fact that manual training is *not* either of certain well-known things. No small part of the controversies concerning manual training have arisen from misunderstandings as to the meaning and force of words. There is substantial agreement among good writers as to the words technical, technological, and polytechnic. The Greek root *tech* is employed to signify an art resting upon higher scientific principles, systematically

developed and adequately worked out in practice. Hence a technically trained man is one well versed in both the theory and practice of one of the branches of applied science; he is an engineer in some one of the many branches of modern engineering, each requiring the mastery of an extended and severe course of study. There is therefore perfect fitness in these names—the Massachusetts Institute of Technology, a school for the different branches of engineering, architecture, and chemistry; the Stevens Institute of Technology, a school for mechanical engineering; and the Polytechnic School of Washington University, a school for three different branches of engineering and for chemistry. The Central School of the City and Guilds of London Institution at South Kensington is a technical school. These schools are all high grade, receiving freshmen at the average age of about eighteen years.

The word "scientific," as applied to a technical school or department, is going into disfavour as too broad and indefinite. Science is applied to every branch of learning which has been developed sufficiently to enable one to study it systematically.

I do not mean that all institutions which call themselves "technical" or "polytechnic" are properly so called. I have several institutions in mind which violate good usage in this regard. In every case the mistake consists in applying the word to schools for young boys, or boys and girls, where no proper

technical training is given. In one case all the pupils are under thirteen years of age.

In Europe the term "polytechnic" is applied to the higher grade of scientific schools, where nearly all the instruction is of a professional character. In England the tendency in the use of the word "technical" is in the right direction. I say the *tendency* in England is right, but it must be admitted that the popular use of the word "technical" is much less discriminating than it should be. English people mean by "technical" very nearly what Americans mean by "industrial," and, as we shall see, that means a great many things. Sir Lyon Playfair says that "in one sense technical education begins in the kindergarten," but he admits that it were better to find other names for the several grades of preparatory training which should precede the strictly technical. Within two years the General Court of Massachusetts has changed the name of the Worcester Free Institute of Industrial Science—for the most part a school for mechanical engineering—to the Worcester Polytechnic Institute, in recognition of the usage I am advocating.

In the use of the word *Industrial* there is the greatest diversity. There is scarcely an institution for boys, from the kindergarten to the University, which has not been called more or less *industrial*. It has been applied to reform schools, to trade schools, to charitable institutions where boys spend half their time at ordinary labour earning their living or a part of it. It has been applied to freehand and to

instrumental drawing, and indiscriminately to manual training schools.

The industries of modern life are very numerous, and each admits of being analysed into its elements and of being systematically taught. But to say that a school or a study is *industrial* because it involves training which may be directly useful in one or more industries, seems to me a very objectionable instance of synechdoche. In England and in Europe generally the word is applied to schools where special trades or small industries are taught. The industrial schools of England are limited to schools of weaving, dyeing, and the like, in manufacturing towns. They take a wide range on the Continent, though they are individually very narrow. For instance, in 1883 there were forty-four trade schools in the Duchy of Baden. The trades taught—one in each school—were clock-making, watch-making, straw-plaiting, wood-carving, pottery-making, hat-making, basket-making, ribbon-making, cardboard-box-making, etc. These schools are at once and all the time productive. By confining the attention of the pupils to a narrow field and by giving to hand work several hours per day, pupils are soon able to produce saleable articles, and hence the schools are always factories. Such are industrial schools as understood abroad.

Now a manual training school is neither a technical school nor an industrial school. It is far too elementary to deserve the name technical or polytechnic. It forms a fine foundation on which to build up a

technical training, if the pupil possesses the requisite natural abilities and aptitudes. On the other hand, it is too wide and too free for the term industrial. In a manual training school the aim is not the narrow one of "learning a trade." Neither is dexterity sought in special operations which may be only small parts of even a trade. Neither is there any thought of manufacture with a view to selling something which will yield an income. The object of every feature is education in a broad and high sense.

Manual training covers the two features of drawing and tool work. The former I have already outlined. The tool work includes both the theory and practice of a great variety of tools on an equal variety of materials. In both these features there are elements of what has usually been called "art work," such as the study of ornament, its construction in suitable material, and its representation on paper. This fact is quite consistent with the idea that manual training, though not a specialty in itself, should underlie specialties. Art work is a specialty, as mechanical engineering or dentistry is a specialty, and like them it may properly have due consideration in a preparatory course. That is the right word; *preparatory* to specialties, without being special itself. We have seen that our elementary education is one-sided, that it does not sufficiently touch the human life of to-day. All elementary education should be preparatory to life, and universal elementary education must be broad enough to touch life "all round." It is not

assumed that pupils whose education has included manual training are prepared for special vocations, but they are so generally trained that all avenues into life are equally open. Of course it does not follow that they are equally suited for all avenues. Here comes in the personal, the subjective element. Natural capacity, innate gifts, may now assert themselves without distortion and deception. Without proper education people deceive themselves as to their tastes and aptitudes, and they are deceived as to the world around them and the relative values and dignities of different forms of activity, and the demands and possibilities of different occupations.

In the same way in which manual training leads up to art work, it also leads up to scores of specialties in industrial, agricultural, and commercial life. It leads up to technical schools and to technical pursuits. In this way it restores the balance. The literary work of the school leads up to pursuits demanding extensive literary preparation; and the mathematical work leads up, first to the application of arithmetic in counting-rooms, then the higher mathematics lead to the elaborate analyses of engineering, higher physics, and theoretical astronomy.

From this sketch something of the motive of manual training may be inferred. Its influence is subjective. In the case of tools, intelligent use, rather than dexterity, is aimed at. Manual training is limited to teaching and learning the use of tools, the methods of working materials, and the construction and use of shop-drawings, where the *mastery of*

tools, *materials*, and *methods* is the immediate end in view. The instruction and practice deals with general principles, and the forms used in exercises are as typical as possible. While in hand they are particular, definite, and precise, because every concrete exercise must be particular, however general may be the application of the ideas involved.

Some one has suggested that "manual culture" is a better name than manual training, inasmuch as the manual features take on so clearly the form of culture. The suggestion strikes me with great force. It is perhaps too late to use it as a name, but it may be used with profit in setting forth in words the character of the training.[1]

In wood-work we have *three* distinct sets of tools—1, for joinery; 2, for wood-carving; 3, for wood-turning. We have four distinct series of processes for working and using wood—1, joinery; 2, wood-carving; 3, turning; 4, pattern-making. The last is a combination of the other three, and uses their tools. But the principles involved in pattern-making cannot be understood without moulding and casting. Hence moulding in sand and casting with some suitable material must enter sufficiently to make every detail and characteristic clear and reasonable. There is of course considerable difference in the details of tool work in the different schools, though they agree closely in spirit and the theory of shop work.

[1] The motto of the St. Louis Manual Training School is, "The Cultured Mind—The Skilful Hand." With equal propriety it might be, "The Skilful Mind—The Cultured Hand."

One school makes little of wood-carving, much of clay modelling; with another the reverse may be the case. One school casts with iron or white metal, another with plaster. These differences are natural, and no greater than those which exist between their ways of teaching botany, history, and grammar.

Neither the tools employed nor the materials used in our shops are original with us, but the methods of instruction are in a measure original. No apprentice ever learned his trade in a commercial establishment, as our students gain their mental and manual culture in connection with the tools used in different crafts. So no counting-house boy nor sea-captain's son learns mathematics as they are taught in schools.[1]

[1] A case in point occurs to me. One vacation I chanced to meet in Minneapolis two brothers, jewellers, who were deeply interested in an impending eclipse of the sun, and who were ambitious to furnish correct time to their patrons. They were from New Bedford, Mass., and in their boyhood had been on whaling voyages with their father, a sea captain, and had learned to use the sextant and *Bowditch's Tables* to determine latitude and longitude. They had inherited the sextant and *Tables*, and used them remarkably well for solar observations, but their determinations were crude and too inaccurate for modern watches. They therefore appealed to me for aid in determining the error of their "standard" clock. This aid I was delighted to give, and I soon won their entire confidence. One day as I was using a table of logarithms, one of the brothers asked me, with bated breath—for they did not wish the public to know that they were in any way dependent upon others—if I would not some time explain to him what a *logarithm* was. He had used logarithms all his life, he said, as his father had before him, but neither of them had any idea of what logarithms were, nor why it was that Bowditch's formula should give them the error of their clock. I replied that nothing would give me more pleasure, but I should have first to teach him algebra; then if he

I have spoken of the breadth of culture our boys get in connection with woodwork. I should add that every available variety of wood is used—hard and soft, coarse and fine, brittle and tough, green and seasoned. By personal experience the students learn much of their relative values for different uses, and that experience prepares them to appreciate such further information as may be incidentally given by the instructor or be obtained in books. Botany, however, is a science study and not a manual study. It is very important, as are the economic matters of arboriculture, cost, traffic, and the preservation of lumber; but such discussions, valuable as they are, must not be misnamed "manual."

There is another manual feature in connection with this course in woodwork which is peculiar to a manual culture school. I refer to the drawings in connection with every exercise in exact construction. I say "exact" construction, because there must be many shop exercises in which the aim is not definite forms but a definite knowledge of how to manipulate particular tools. Many pieces of raw material must be completely used up in these introductory exercises. In learning to set and shove planes, much stock must be reduced to shavings. In

wished to understand the formulæ he must learn trigonometry, and something of astronomy; without these he would still be in the dark. He knew none of these subjects, and sorrowfully gave up all hope of ever knowing what a "logarithm" was.

That is the way boys and men learn trades and sometimes professions, from A to Z. That is the way we do *not* teach.

learning how to hold the gouge in turning—in forming cones and conoids, convex and concave—many a "blank" must disappear in chips. It is the same thing in every fundamental process, and the judicious teacher places great emphasis upon this *mastery of the tools.*

During these introductory exercises no drawings are necessary. The teacher must *show* how to do things himself, and why he does them thus and so, and his work and the order or his steps, when actually observed by his pupils, are a sufficient guide. But when the pupil has intelligent notions of how a tool should be used, and sufficient practice in the right direction to cause that direction to appear to be the best, so that he will henceforth follow it, *quantitative* exercises may be introduced. The introductory ones may be called *qualitative.* Quantitative exercises should always be preceded by scale drawings. But before I speak of drawings I must digress a little.

The reasonableness of the introductory exercises I have described as preliminary to construction is so clear that all ought to see it. There are wrong ways of holding a tool as well as there are wrong ways of holding a pen, a pencil, a violin, a musket, a tennis racket, and a fork. Correct ways generally have a scientific basis, either economical, dynamic, or artistic. On the other hand, wrong ways are wasteful, weak, and awkward. In other branches of study where the hand is employed great attention is paid to style and good form in manipulating the instrument, whatever

it may be, and for good reasons. It is held to be a misfortune for a child to get into wrong methods or bad habits. Music teachers and drawing teachers, whose pupils come to them after more or less self-teaching, complain that there is much that must be unlearned before a good beginning may be fairly made. This picking things up by one's self is often the cause of awkwardness and clumsiness which one never outgrows.

The same is true of tool-work. Most boys have some tools at home. They are generally poor tools, illy kept, with no proper place for using them. The result is that even those who fancy that they know how to use them have very little of value to show for their efforts in learning by themselves. They find at once the advantage of a teacher, and that there are many wrong ways to one right one. They find too how hard it is to overcome bad habits once firmly fixed. Boys who come to the school with the reputation of exceptional mechanical ability rarely maintain the reputation.

Hence I conclude that the practice of furnishing boys with kits of tools, with no adequate instruction upon keeping them in order and upon methods of using them, is of questionable value. The gift of tools should be followed by the gift of suitable instruction. This instruction cannot be properly given by books; only actual demonstration can furnish what is needed. I therefore desire to caution teachers who are in the habit of urging their pupils to construct frames, models, and apparatus at home with

such tools as they can scrape together and without any hint as to how to use them. When such homework is closely inspected, it always shows great inaccuracy and weakness in details.

Returning now to the question of scale-drawings, such as should accompany exercises in construction, I begin by saying that the drawing should precede the construction itself. In other words, drawing is an intermediate step in an executive performance. As a rule the design should be the teacher's. He alone knows what the next logical step in the development of his subject is. This step has distinct reference to what has already been done, and it places in clear relief something new either in kind or degree, or both.

There are different ways of communicating this design, which of course has been very deliberately adapted to the pupils who are to execute it. I assume that the class is taught as a unit with supplementary individual instruction where necessary. I shall elsewhere speak of the methods of providing for both slow and for rapid pupils in conducting class-work. Now as to this design. Several different plans may be followed.

1. The pupils may have text-books in which accurate scale-drawings of the exercises are printed in order, with printed directions. In this case it might be thought unnecessary for the students to duplicate them.

2. The teacher may exhibit a drawing on a large scale, and explain it as much as may be necessary to give the pupils a full understanding both of the

drawing and of the *form* it represents. The pupils then place the drawing, neatly executed to scale, in their books.

3. The teacher may exhibit the model—possibly in duplicate or triplicate—and allow the pupils to examine it minutely, and then draw it to scale, getting the correct dimensions from direct measurement.

4 The design may be given entirely by dictation, and be drawn as dictated, while the pupils see no model.

Of course two of these methods may be combined. Sometimes one method may seem best and sometimes another. The teacher must be guided by the state of his class, and adopt that plan which is most stimulating and fruitful in clear, vigorous thinking. The teacher must bear in mind that his class at the start has had no practice in reading drawings. The force and meaning of every new word must be made absolutely clear. Such words should be written, copied, and distinctly pronounced. This communication of the design should precede all directions for its execution. The execution is supposed to contain some new process, and to require a particular sequence of new, combined with familiar, steps. All this must be fully explained and illustrated by the teacher, while the members of his class give close attention. His aim should be to set forth the requirements of the exercise so fully and clearly that no repetition to individual pupils may be necessary.

This *instruction* should never be slighted. The pupils are not to be left to guess as to the order of

the steps, or as to the nature of the steps themselves. As I have before said, there are many wrong ways for one right one, and no good is accomplished by letting a boy go wrong. Upon this matter of class instruction there is substantial agreement in its favour among practical teachers. Professor Ordway, of the Tulane High School, New Orleans, says he is opposed to the "Russian" method.[1]

I shall speak of the advantages of the "Russian" method in another place.

A shop exercise is something more than an exercise in form-study. It includes the study of a form, and to that extent it gives meaning and force to the drawing. But the form of the model or the finished piece is but a small part of what is to be learned from its execution. It should involve a new process, a new test of precision, a new demand for patience, the uses of a new tool or a new combination of tools, a new insight into the *rationale* of construction with given material. These points and these alone justify the exercise when the form is already clear in the mind.

This discussion leads me straight to the question—How many exercises should the pupil have in a single shop? I answer—When all the tools are mastered; when the different processes are so clearly understood that the pupil naturally makes a judicious choice if

[1] The credit of first analysing mechanical processes into simple elements, and then teaching those elements, one at a time, to all the members of a class simultaneously, as one would teach the elements of Euclid, should be given to Victor Della-Vos, Director of the Imperial Technical School of Moscow, founded in 1868.

told to outline a plan of execution; when the typical forms are fairly mastered, with suggestions of their different uses in construction; when the pupils are reasonably familiar with different materials, and the peculiar demands they make upon the worker; when they are able to "lay out" and execute complicated designs from the drawings, they are then ready to pass on. Valuable as the mental drill on such work may be, the moment it ceases to be stimulating to the mind, and becomes a mere repetition of things already well known, that moment it should cease. No "long terms of service," no "wearisome repetitions," no mere "drudgery" of the muscles, no mechanical "automatism" which leaves the mind unoccupied while the hands are busy, are to be allowed.

Nearly every one of the phrases in the last paragraph is quoted from objectors and critics of manual training. I shall have more to say in a following chapter on the objections which have been urged against both the theory and the practice of manual training.

Thus have I presented the characteristics of manual training, and to every one familiar with industrial operations it must be sufficiently clear that they are strictly educational. To be sure, I have confined myself for the most part to exercises in woodwork, because that is the realm of manual training most accessible and best suited to the circumstances of average schools as the first feature of tool education. But *mutatis mutandis* they apply equally to any department of manual culture.

The reader will have noticed that I have not definitely given the stage of mental and physical advancement of the pupils. There is seldom any necessity for mentioning physical qualifications, for no one having the mental preparation falls short of the physical strength and maturity necessary for the successful study and practice of tool-work. Of course I am not talking of *manual labour*, as that phrase is generally understood; with that we have directly little or nothing to do. The proper mental maturity rarely comes before the fourteenth year in a pupil's life. I think of the class as about fifteen years old.

CHAPTER IV.

EXERCISES IN JOINERY.

IN this chapter and the five following I propose to give an outline of the tool-work in the several grades of a manual training school, with an occasional illustration of the exercises. The character of the instruction and mental activities which accompany the execution of the concrete exercises will be hinted at by some specimen sets of examination questions and answers.

In my last chapter I spoke of the drawing which should precede, or at least accompany, the first exercises with wood-working tools. The drawing is really very simple in character; the manual part is at a minimum, the mental at a maximum. The object is to accustom the pupil to the reading of a drawing. Drawing is a language which every person ought to be able to read fluently. Of course the scope of the language is narrow, and for the most part it is concerned in expressing form. All definite forms are either geometrical or based on the geometric. In highly finished drawings colour is used or is represented conventionally, shade and shadows appear executed with pen or brush, and pictorial effects are aimed at, but there is little occasion in a series of shop-drawings for elaborate work.

The fundamental forms—cube, sphere, cone, and cylinder—are supposed to be well known to the pupils—both the objects themselves and their simple projections. Secondary forms, such as prisms, pyramids, solids having curves of higher orders, and their combinations, are generally new; but whether new or not, no one can become a reader of drawings without abundant practice both in the making of drawings from objects and in comparing objects with their drawings. The last step leads up to seeing the object in its projections, which constitutes the act or reading. It is probable that some of my readers have had little practice at this work, and they can readily see how innocent of skill in this direction is the average pupil of fourteen years.

Take, for example, this drawing which gives four projections of a somewhat irregular but plain-faced block. The arrangement of the projections accords with the best usage. The naturalness of the grouping may be shown as follows: Suppose the block to be lying on the floor, and imagine that we place over it a glass box consisting of a top, a front, and two ends. Next imagine orthographic projections to be made on the exterior of the glass faces as the block is seen through

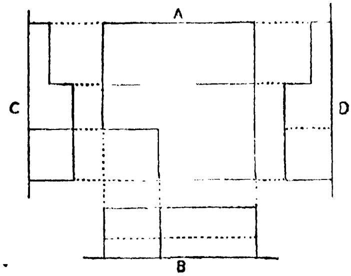


FIG. 2.—PROJECTIONS OF A PLANE BLOCK.

the several plates of glass. An orthographic projection is made by a line always perpendicular to the glass face; it should show the outline (contour) of the object, and each defining or division line on its surface. Invisible lines are shown broken.

Now suppose that the three vertical faces of our glass box are hinged to the top so that they can be revolved up into the plane of the top. If we imagine that they are so revolved, and that all four are then laid upon a table, their grouping will be as shown in my drawing. A is the "top view," as shown on the top plate; B is the "front view," as shown on the front plate; and C and D show the "end views." Of course a "back view" could also be obtained in a similar way, but it is seldom necessary to show all the views. The lines which extend slightly beyond the ends of the projections may be taken to represent the floor-line. Of course the floor-line is lacking in the top view. In the language of many draughting-rooms, the top view is known as the "plan" or "horizontal projection"; the front view is known as the "elevation" or "vertical projection"; and the end views are known as "side elevations" or "side projections." There is no absolutely uniform method of grouping in use, but the method given above is earnestly recommended to all educators and draughtsmen. It is simple, logical, and convenient. A person familiar with projection drawings will readily see the exact shape of the object represented in Fig. 2, so that it would be easy to cut its form out of a mass of clay, plaster, or wood. To the

novice the seeing of the form is no simple matter. Practice in making projections of irregular blocks and in evolving forms from the drawings is necessary to the proper cultivation of the power to read. When the object is less simple—when, for instance, it has inclined planes and curved surfaces—the reading requires considerable close study. I venture to give a more difficult example.

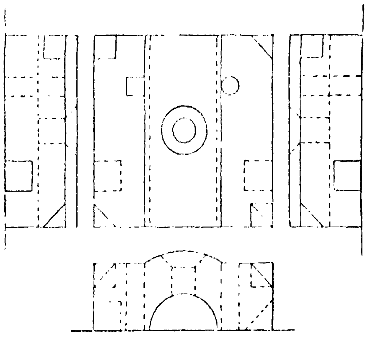


FIG. 3.—PROJECTION DRAWING, LESS SIMPLE.

The general shape of the object is readily seen. The difficult parts are the corners (no two of which are alike), and the recesses in the sides. The reader will be richly repaid for his effort if he carves the exact shape out of soft material, making it eight times the size of the drawing—*i.e.*, doubling the linear dimensions.[1]

[1] Perhaps I ought to say that, starting with full rectangular corners, the front corner on the left is cut off by a single plane; the other front corner is cut off by two inclined planes; the rear corner on the right is

Each pupil generally has a blank book in which he draws the series of models he makes in woodwork. The greater part of the designs are given to all the members of the class in common. A few are designed by the students themselves; they are based on those already given by the teacher, and on such specimens of work as the students may have seen outside the shop.

This habit of drawing exercises previous to their construction is not maintained through all the different shops. The practice of the school is to discontinue any exercise or process the moment it ceases to be of decided educational value. This stage is reached during the second and following years in so far as the exercises in metal are concerned. The reading of simple drawings has become a second nature, and the students resort naturally and easily to projection drawing as a kind of clear expression. In some schools I have noticed that instead of requiring the students to construct their own drawings the teacher issues "blue prints" of the drawing he has himself made. In some cases the drawings are engraved and printed. Of course either of these methods results in an apparent saving of time, but I doubt its real utility during the first year in school. The boy begins with no ability whatever to read a drawing. His projection

cut by two planes, one vertical, the other horizontal; and the remaining corner is cut by three planes, two vertical and one horizontal. This exercise is not taken from any school list. It is inserted here to illustrate the subject of projections.

drawing and his shop-work begin at the same time, and he needs all the practice he can get. It is exceedingly important that he should associate the lines in his drawing with the lines he must make on his material in "laying out" and in cutting his piece. If he makes every line on the drawing himself, and puts down every figured dimension, his attention is called to those points more strongly than if the finished drawing is placed in his hands and he simply looks it over. In the end I doubt if there is any true economy in issuing drawings during the first year in manual training. The series of exercises in joinery usually numbers twenty or thirty models. "Extra" numbers should always be within reach for the benefit of those who are quicker or more skilful than their fellows, and who are eager to try their hands on something comparatively difficult. Moreover, a certain number of designs should be required of every student. A few models are shown below in order to illustrate the methods of making drawings to scale and properly "figuring" the same.[1]

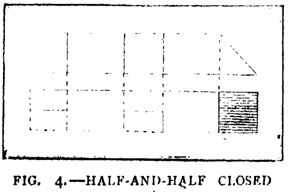


FIG. 4.—HALF-AND-HALF CLOSED JOINT; HALF-AND-HALF OPEN JOINT; MITRE JOINT.

Fig. 4 shows how much may be put on one simple drawing. This is Exercise No. 4 in the series.

[1] A full series of such drawings as are given in the author's school in St. Louis, Mo., is shown in his book, *The Manual Training School: its Aims, Methods, and Results.* D. C. Heath & Co., Boston, Mass.

Fig. 5 is Exercise No. 13 in the series. The "stock" issued to each pupil is a piece of rough lumber about 2¼ inches square and 8 inches long.

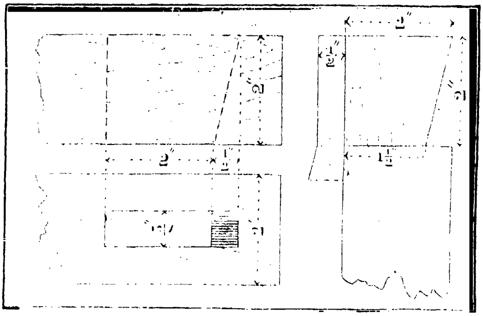


FIG. 5.—A HALF-DOVETAILED MORTISE-AND-TENON JOINT, WITH A KEY.

This exercise shown by Fig. 6 is No. 19. It requires precision and a clear head. The work must be laid out very systematically, and be executed with patient care.

It would be easy to multiply specimens, but this is not a text-book. My purpose is not so much to give the details of a course in manual training, as to give the reader so clear a notion of what manual training is, that, supposing he is skilled in the theory and use of

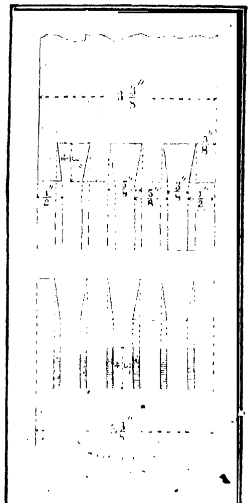


FIG. 6.—A DOVE-TAILED JOINT WITH SEVERAL TONGUES.

tools, he may be able to devise such a course himself.

The work of the teacher is by no means simple. He must be skilled in suiting the action to the word, and equally skilful in suiting the word to the action. He must be quick to recognise and adopt a logical order, quick to divine a boy's difficulty, and able to see the immediate cause of failure.

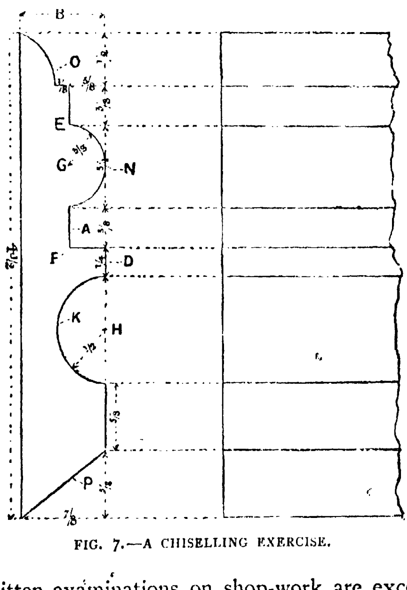


FIG. 7.—A CHISELLING EXERCISE.

Written examinations on shop-work are excellent for a variety of reasons. They tend towards a correct vocabulary, precision of statement, the spontaneous use of diagrams in explanations, and to

attention to details. To illustrate this point, I present a series of questions upon a "chisel exercise." The drawing (Fig. 7) made by the pupils was as here shown. Only an "end" view and a portion of the "top" view are given. The piece should be six or eight inches long, as the section is uniform from end to end.

The material used was pine wood, about an inch in thickness. The stock was first to be planed into a rectangular prism 4½ inches, by 8 inches, by ⅞ of an inch. The student is supposed to have heard a lecture upon the piece, and to have seen the teacher begin its execution step by step. The pupil is supposed to have made the drawing as shown above, to have laid out the drawing on the stock, and to have executed the exercise himself. He is therefore in condition to answer these questions intelligently from his own experience.

Specimen of a Written Examination in Shop Work.

1. Why do you mark the faces D and B (with an X) when you plane the block?

2. Why do you set the thumb-gauge by the ruler instead of by the markings on the gauge?

3. How many parallel lines do you mark on the face D?

4. Why do you gauge from "B" instead of from the other edge?

5. What dimension do you set on your gauge for the corner to the left of (or above) the letter D?

6. Which of the parallel lines do you mark with a pencil instead of with the gauge? Why?

7. How do you find the centres G and H? And how do you support the foot of your dividers while drawing the semicircle K?

8. What "scoring" is to be done in the exercise, and with what tool?

9. Why is it better to "score," than to try to get on without it?

10. What is meant by "working with" and "working against" the grain?

11. Why do you use the chisel with the bevel down in cutting out the bottoms of the grooves E and A, and with the bevel up when smoothing out the sides of the grooves?

12. What tool do you use to cut out the semicylinder K?

13. Tell, by sketch or otherwise, how to sharpen the tool you just named.

14. How can you tell if the groove K is semicircular at any point in its length?

15. Why do you use the chisel and not the gouge in rounding off the surfaces N and O?

16. Can you use the gouge with the concave side down? Why so?

17. What tools do you use in chamfering the part P?

18. Does the finished exercise suggest any uses to which similar work is put in house-building or furniture?

19. Have you ever noticed how such similar mouldings are made, by hand or by machines? If

of more than one piece, show how the pieces are combined.

20. What is the most difficult part of the exercise, and why?

Of course the 18th and 19th questions bear, not upon the manual training exercise, but upon the interest aroused in mouldings generally, and upon one's habit and opportunity for close observation. It would be easy also to wander off into such subjects as the cost, growth, and durability of wood, matters lying for the most part beyond the pupil's personal experience, and derived second-hand from book or from the teacher. Such collateral information may be very valuable and very interesting, and the shop may be the most fitting place to impart it, but it is not strictly manual training.

It will probably be interesting to my readers to see a set of correct answers to the above questions. I therefore insert them here.

Answers to the Questions.

1. Faces B and D are the first ones planed smooth and true. Considering them true, the try-square and gauge are to be used from those two faces; so we mark them to identify them.

2. After sharpening the gauge-point, the point is not always left true in relation to the markings on the gauge; so it is more accurate to measure with the rule.

3. Seven.

4. Because B and D were marked, and that corner is more likely to be true than the other.

5. Just two inches, for that is the exact distance from the face B.

6. I mark the line where the inclined face P intersects the face D with a pencil, because the corner does not form a right angle, and the crease formed by the gauge would mar the corner.

7. Draw a line containing E and A, 3/8 of an inch from the face D, and locate G 1 1/4 inch from B. The centre H is 2 3/4 inches from B. To support the foot of the dividers at H, clamp the piece against another thin piece of wood (that has been planed true) in the vice so that the point may rest in the joint between the two.

8. Score down to near O with the 1/2-inch chisel, and to near E and F with the 1/4-inch chisel.

9. By scoring I cut the wood across the grain, and so destroy the fibres to a great extent. This renders it less liable to tear up across the gauge line.

10. [Here the student should make two sketches showing the point of the chisel entering the wood, on a cross-grained piece.] When the chisel works "with" the grain, the surface is left smooth; when it works "against" the grain, the surface is generally left rough, from the tearing up of the fibres.

11. The chisel cuts more smoothly when used bevel outward, but in the bottom of a groove the handle prevents its use in that manner.

12. The 3/4-inch carpenter's gouge.

13. Place the tool on the stone at an angle of about 15° to 20° Rotate the tool slowly as it is

ground, so that the bevel will form a true conical surface. Try the edge with the try-square, so as to see that the edge is a true circular arc, square across the gouge. After the gouge is ground to an even edge, wipe off the water, take the slip-stone with a little oil on one of the flat sides, place it upon the bevelled surface, tilt it up a very little, and rub the ground edge back and forth with a rotary motion. The slip-stone should be used till one can feel a "wire edge" along the entire edge on the inside. Then the round edge of the slip is to be put into the groove of the gouge and held against the concave face, and rubbed till the wire edge is gone. The oil may then be wiped off, and if the edge feels smooth to the hand when drawn backward across it, it may be assumed that the gouge is sharp. [The student may use sketches to illustrate the operation of sharpening.]

14. Put the corner of the try-square into the groove. [This should be shown by a figure.] If the groove is cylindrical, the try-square will just touch the bottom of the groove at the same time that it touches the sides. The exterior edges of the square form a right angle, and if the cross-section of the groove is a semicircle, the square will just touch it in three points.

15. The chisel makes a plane cut, while the gouge cuts a groove. The former is therefore much better adapted to making a convex surface. There is always some danger of cutting too deep with the gouge.

16. Yes, but I should be pretty sure to spoil my work, for the edge would touch at nearly all points,

and would certainly get forced down into the wood too far. Besides, the handle would soon be in the way.

17. The one-inch chisel.

18. Yes, mouldings for cornices, door and window frames, door panels, picture frames, etc.

19. Yes, I have seen lots of them planed out by machinery in a planing mill. Sometimes they are made by hand. The planes are shaped to fit the moulding. Sometimes two pieces are fitted together so as to form what appears to be a very thick moulding, but there is really a hollow space left inside.

20. The most difficult part of the exercise is the laying it out, because it requires more care. A mistake in laying off means a finished exercise which is wholly incorrect.

Some general remarks I wish to make concerning the education contained in all such work. The contents of the study may be said to embrace the following:—

1. The characteristics of the various woods, as regards texture, strength, toughness, cleavage, colour, grain, availability.

2. Methods of "laying out" work; use of try-square and gauges.

3. The theory and care (grinding and oil stoning) of gauges, chisels, and planes; the theory and uses of saws.

4. Methods of mortising, paring, sawing, planing, scoring, boring, and polishing.

5. Fastening by glue, pins, nails, screws, wedges, and dovetails.

6. The alphabet of joints as approved by experience, and universally employed in construction.

It will be seen that the above includes the results of long experience. There are such things as good usage and bad usage; elegance and ugliness; deftness and clumsiness; logical and illogical orders—in the execution of an exercise and independent of the design as shown by the drawing.

It is very important that the teacher omits none of these things. There is danger that he may from lack of a clear perception of them on his own part, or from indifference or indulgence, fail to bring them out properly in his instruction.

The impression is far too general that there is nothing worth teaching or requiring teaching in actual tool-work.

This impression is wholly wrong, and I cannot too strongly urge instructors of tool-work to teach minutely, to show fully and exactly every new detail of every exercise.

Familiar steps in a process may be passed over with only a reference to matters already explained, but new points must no more be left to the pupils to find out for themselves, than the teacher of music should leave beginners to find out for themselves how to execute a new movement on the violin or organ. All the details of manipulation are based on reason and common-sense, and the reason and good sense should always be set forth. More and more am I impressed with the importance of this matter.

CHAPTER V.

EXERCISES IN WOOD-CARVING.

WOOD-CARVING differs from joinery both in the character of the tools used and the general nature of the work. "Joinery" derives its name from its relation to joints, by which one piece is connected with another. This is the most difficult part of construction, yet joinery, as used, includes much more than a study of joints. Wood-carving deals not with construction, but with ornament; not with joints, but the faces and bodies of pieces.

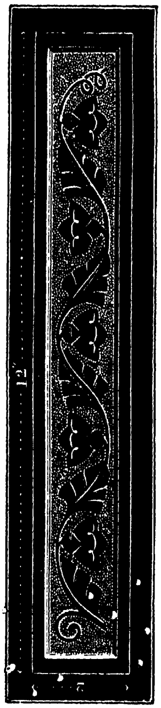


FIG. 8.—PANEL WITH ENGRAVED TENDRIL.

Wood-carving consists of two parts, engraving and relief work. In the former, figures are formed by cavities from which the material has been removed by suitable tools. In relief work, figures are formed by portions of the material left above the general face of the piece by the removal of adjacent material.

Fig. 8 is a simple exercise in engraving, a purely conventional design.

Only two tools (gouges) are used in the execution of this exercise. A drawing is first made on the face of the block, the *width* of the portions indicating the *depth* of the cutting.

Fig. 9 is a specimen of carving.

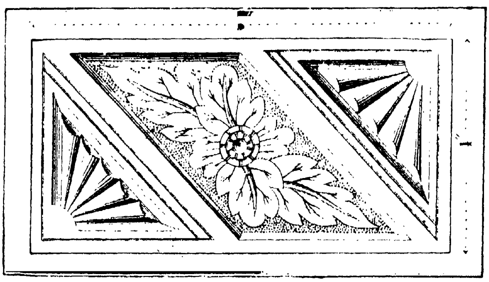


FIG. 9.—CARVED DIAGONAL PANEL.

This is Exercise No. 12 in the series. It requires specific directions and a variety of tools.

Considerable wood-carving may be done with ordinary bench tools, though fine work should not be attempted with coarse instruments.

Fig. 10 shows an exercise with carpenter's gouges. The student learns how to meet the grain of the wood at all angles, and how to produce curved surfaces with accuracy, in this exercise.

There is a great variety of wood-carving tools, but the number needed in a school is not more than ten or twelve.

The material carved should first be soft woods,

such as gum, elm, poplar, and pine, the first two of which split with great difficulty. Later exercises may be in harder woods, such as walnut, mahogany, rosewood, and oak—the last being preferred for high relief. But exercises which require high relief belong to special schools, not to a general manual training school.

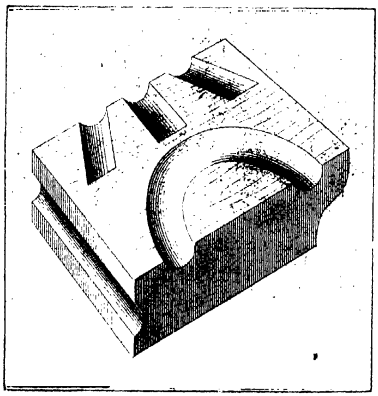


FIG. 10.—A GOUGE EXERCISE.

In this work, which should hardly occupy more than four or five weeks (forty or fifty hours), the aim should be to acquire a fair familiarity with the special tools; to learn how to lay out a design, and proceed with the work; to form a habit of close observation of ornament; to cultivate correct taste in the matter of surface ornamentation, and to enable one to better appreciate artistic and manual skill.

Though the progress made in wood-carving may be very little, it should include at least one attempt at original design based upon observation and the lessons already given. This work, like joinery with soft wood, may be undertaken with profit by girls.

CHAPTER VI.

WOOD-TURNING.

THIS department of woodwork serves many valuable ends. Here first the student comes face to face with a powerful machine driven at high speed. At first the lathe is a little frightful, and the student takes up his keen-edged tool with a sense of personal danger. No small discipline of the nerves is involved in a gradual mastery of the machine. One must learn just how to manage it; how to take it apart; how to clean, adjust, and use it. He must be told where danger lies, and how to avoid it.

Wood-turning is fascinating to every one. The speed with which work may be done, the perfect fitness of the lathe tools for their peculiar work, and above all the grace and beauty of the forms produced, make wood-turning very attractive. The element of symmetry enters into all turned forms, and constitutes an important factor in their beauty. Cones, cylinders, concave and convex surfaces of endless variety, follow each other rapidly and easily as soon as one has mastered his chisels and gouges.

Turning is a fine art, and the student's judgment and taste are efficiently cultivated. No sooner has he well entered on this work than his eyes are opened to see forms on all sides which had previously escaped

his notice. Every piece of furniture, every balustrade, and a thousand articles of use and beauty, embody ideas and forms which suggest lathe work, and furnish opportunity for the exercise of good taste. Unfortunately he too often sees evidence of poor taste where good taste would have been so pleasing and apparently so easy.

I cannot follow wood-turning through all the details of "outside," "face-plate," and "chuck" work, nor can I more than hint at the long list of objects of use, beauty, and ornament which every pupil may appropriately exercise upon while he masters the various phases of the work.

The drawings for turning are often but half projections, the element of symmetry with respect to an axis being assumed. As an example I give one of the early exercises in Fig. 11.

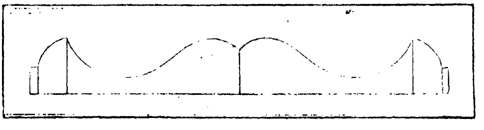


FIG. 11. -REVERSE CURVES. SMALL BALUSTER.

The straight line represents the axis of the piece. It will be seen that at a certain point in the outline (or at a certain *circle* in the surface) there is a change from concave to convex, and then again from convex to concave. The passage from either to the other, from left to right, or right to left, involves a nice point in the manipulation of the tools.

In hollow work the internal as well as the external contour line must be given. I venture to insert a single unfigured drawing of a face-plate exercise, Fig. 12, for the purpose of showing how drawings, half-projection and half-section, are used.

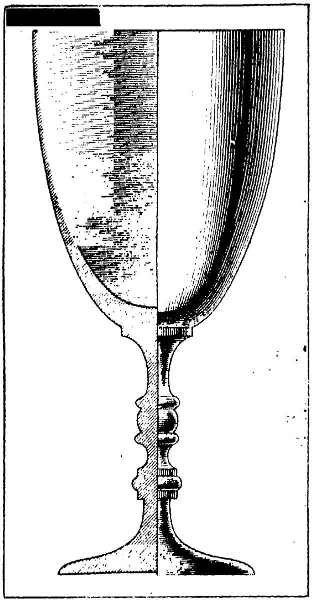


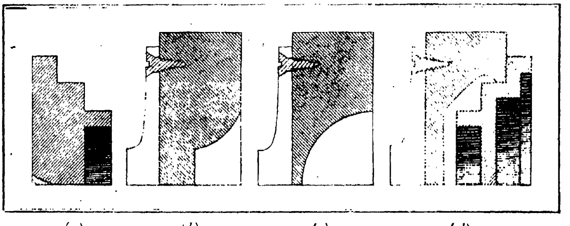
FIG. 12.—WOOD-TURNING EXERCISE WOODEN GOBLET.

In a "face-plate" exercise the squared end of a block is screwed firmly against the centre of a plate, which in turn is screwed upon the extremity of the revolving shaft.

The tools may be applied to the exterior faces, or they may be used to cut directly into the face of the block.

Sometimes a thick flat piece is secured to the face-plate by several screws. This is always so when a "chuck" is to be formed. A "chuck" is a block hollowed out so as to receive and support a second piece. Some objects require turning over their entire surface; they therefore cannot be screwed to any-

thing, nor can spurs be forced into them while in the lathe. They must be held firmly and yet in such a way as not to mar their surfaces. This is effected by means of a wooden chuck. Fig. 13 represents a series of operations involving a chuck.



(a) (b) (c) (d)

FIG. 13.—CHUCK-WORK.

Four stages are represented by *a*, *b*, *c*, *d*. In each case a *half-section* of the work is shown, the axis of the lathe being along the bases of the figures.

In three of the figures half of the plate is shown.

(*a*) Represents a half-section of a block on the face-plate screw. The exterior has been turned off into three-stepped cylinders, and a cylindrical opening has been sunk into its face. We must now suppose that a two-cylinder opening is wanted in the back or left-hand side. The block must then be taken off, turned round, and inserted in a *chuck*. (*b*) Shows the chuck screwed to the face-plate and partially cut out. For the sake of the practice, the chuck-cavity may be made to take the form of (*b*), showing a convex outline; or concave outline, as shown in (*c*), where it is a hemispherical cavity; or (*d*), where it has just the

form to support without injury the first piece (*a*). When the piece is accurately carried by the chuck, the double-cylindrical opening may be cut out of the original block, leaving but a skeleton of material in the finished piece. This exercise is very interesting, and admits of great variation.

It is obvious at a glance that this work offers excellent opportunities for the exercise of the faculty of design. Teachers should be cautious, however, not to require attempts at designing until the students have received a wide training in the elements.

In wood-turning as well as in joinery the instructor must *teach* the manipulations minutely. Students who are left to themselves invariably get into the habit of holding the tools awkwardly, and of *scraping* rather than *cutting* the material. The tools must be kept sharp and entirely free from nicks. The turning chisel is a wicked-looking instrument, and must be held with a firm hand.

The beauty of objects made from "built-up" stock is always a surprise. A "built-up" block is made by gluing together several carefully-matched thin pieces of wood of different colours and grains, and then turning a goblet, ring, box, or vase out of the compound material. A union of such woods as rose, maple, walnut, gum, mahogany, tulip, oak, and cedar produces a fine effect.

It is hardly necessary to add that very young boys should beware of the turning lathe. While accidents are very rare among properly taught boys of fourteen and fifteen years, I question seriously the wisdom of

putting boys of less maturity upon power lathes. Neither would I introduce lathes driven by the foot. The muscular exercise of driving a lathe is very severe, and is so absorbing that what is done in the way of turning is very unsatisfactory. I suggest that lathes should always be driven by power, and that every boy should have his individual kit of tools, and should have the exclusive use of a lathe during his shop hours. Of course one of the first things he is to learn is to put his tools in order and keep them so. In all wood-working shops, each student should have his individual set of edge tools. Let the school own them if you please, but while he uses them no one else should use them. If any one questions the wisdom of this suggestion, let him set three or four boys to using the same chisel or plane. He will find that the plane will seldom be in good order, and that the boy who has the plane in his hands is never the boy who dulled it. The "other boys" are always the careless workmen, and they should be made to grind the plane. The cost of good wood-working tools is very small.[1]

[1] See Appendix for lists of tools and their cost.

CHAPTER VII.

PATTERN WORK AND MOULDING.

No work available for school shops more abounds in problems which must be solved by intelligent thinking than this. A pattern *derives* its final dimensions from the detail drawings, which show the exact dimensions and proportions of the finished work, but it *copies* none of those dimensions. A piece which requires finishing on all surfaces, and which is to be "so long, so wide, and so thick" when finished, must have a pattern of wholly different dimensions. This dimensional difference is due partly to allowance for material to be removed in finishing, partly to shrinkage in the material which is to be poured into the moulds, and partly to the necessity of "draft."

But patterns differ in other ways from the pieces which they are to help to produce. It would require a long chapter and numerous illustrations to explain even partially the intricate matters relating to "cores," "core-prints," and "partings," and to the art of skilfully "dividing" patterns. It must suffice if I repeat that the work is exceedingly stimulating to a boy with a logical mind. He must understand and plan his work with reference to a great variety of circumstances.

PATTERN WORK AND MOULDING.

Besides furnishing an admirable opportunity for putting in practice what one has learned of joinery, turning, and carving, pattern-making involves a fair knowledge of moulding in sand and of casting. One must see the entire sequence of operations in his mind in order to take the first step intelligently. This is the fine intellectual part of the work. And one must actually travel the entire road to see it all clearly. To teach pattern-making in detail without making patterns, and without moulding, would be as impossible and as senseless as it would be to learn all the rules of a Latin Grammar without reading or writing a sentence of the Latin tongue.

The woodwork of pattern-making requires no new tools. The moulding requires a special outfit of benches, sand, and a few moulding tools. Twenty-four benches fully furnished may be placed on a floor space 25 by 30 feet. The teacher must be an expert both in the art of moulding and in woodwork.

Before undertaking to construct patterns, the class should have a few days of practice in moulding old patterns. The pupils thus learn why patterns are "divided," why "draft" is necessary, what "cores" are, and what "core-prints" are for, so that when they enter upon the actual work of constructing patterns, they do so intelligently. After such pattern work as may be thought necessary, they should return again to the moulding room and mould their own patterns as carefully as possible, generally with several repetitions.

When the moulds are formed they should generally

be filled with some easily handled material which readily pours and quickly hardens. In my judgment it is sufficient for a school to pour with thin plaster-of-paris. If properly mixed, it gives a sound casting, accurately filling the mould, and when dry it is strong enough to admit of all the handling and inspection that is necessary. To put in a cupola for melting iron, or to use crucibles containing easily melted alloys, would be inconvenient, expensive, and (unless the time given to casting was out of all proportion to its educative value) the amount of casting would be far less than the moulders would need to test their workmanship.

Fifty hours given to pattern-making and moulding is a fair allowance, and the time is well spent.

It matters little what patterns are made and moulded, and what forms are cast, so long as the series is progressive, and the principles are fairly presented and mastered. Pulleys, plain and grooved; a steam cylinder; elbows of pipes; vases; and the entire set of pieces needed in a subsequent shop for the construction of a machine— these may serve for a class. Whenever castings of iron have been wanted for the machine-tool shop, I have generally found it best to send our patterns to a commercial foundry and have them made for us.

It may be best to add a word in reply to those who claim that it is logically necessary to equip a complete foundry and actually cast in iron. To this I have two answers. First, on grounds of economy. We need scarcely one thousand pounds

of castings in an entire year. A cupola which melts less than one hundred pounds at a time is impracticable. Hence ten days of casting would yield over one year's supply if everything was successful, and then there would be a tendency to stop casting so as to avoid expense. We could never cast *just for the sake of testing the moulding*, except at great expense. But many, perhaps most, of the castings that novices make are poor even with plaster, and with iron they would probably be still poorer. But practice, when castings were not needed, would be so expensive in iron that we should be driven into great waste, or our practice would be inadequate.

Secondly, on educational grounds. The intellectual parts of a foundry establishment are the draughting, pattern work, and the moulding. The intellectual parts of the iron melting consist of metallurgical skill in mixing, a feature which belongs to a technical school and not to a manual training school.

Our boys would therefore get nothing from the actual iron-casting but certain very heavy coarse work, requiring more muscle than brains.

I have found that the proper allowance of time for pattern and moulding work is about one-fourth of the shop practice of the second school-year. If there are four working divisions in the class, they may enter the pattern shop in succession, thus keeping the shop in daily use during the entire year. The other three-fourths of the year are usually given to metal work (forging).

CHAPTER VIII.

WORK AT THE ANVIL AND FORGE.

IT was a turning point in civilization when men learned to produce iron and to manufacture iron tools and weapons. It is an epoch-making characteristic of the present age that steel is replacing iron in arts as well as in arms.

It is impossible to fathom the importance of this advance. All arts from architecture to agriculture are affected by it. A new material so uniform in texture as to be almost absolutely homogeneous, so strong, so elastic, so durable, and so abundant, must call into being new arts, and in the arts that have come down to us it raises new standards and demands new laws. Neither the Egyptian, the Greek, nor the Roman can teach us how to produce steel or how to work it. The architecture of steel is to differ from that of stone in the principles of construction and style of ornament, as widely as the Cantilever bridge differs from the full-centre Roman arch. It is difficult to realize the extent to which we are fettered by tradition. We helplessly strive to subject one material to the laws demanded by a totally different material. We construct a pillar of iron and make it look like a tier of marble or granite blocks. We are doubtless upon the threshold of

new discoveries in the way of combinations of steel or iron with silicon and aluminium which will make the principles of metal work in still greater demand. Therefore, it appears that careful training in the principles and processes of metal work is essential to a rational comprehension of the activities which embrace a wide range of human interests. A knowledge of these things is become one of the "conventionalities of intelligence," while their direct personal value as a stepping-stone may be very great.

If objection should be made that there are many metals which we do not touch, and many processes which do not appear in our course of study, I reply: Very true, that was to be expected. No school curriculum should aim to exhaust any subject, whether art, science, history, or language. We cannot teach all subjects, nor need we. Some are better adapted to the development of power than others, but when power is once gained there is no limit to what one may do without the aid of a school. The mastery of one language implies the power to master all languages. The mastery of iron and steel working implies an ability to master the working of brass, tin, and other metallurgical products. We must ever bear in mind that the end and aim of education is not to store up knowledge, but to gain the power of acquiring and utilizing knowledge. It is in executive work that one puts knowledge and experience to real use.

I hope that no one will be led by these statements

to think that in a manual training school the pupils actually reach the stage of mastery of any art in the curriculum. What I said of mastery was true, and it is true that mastery is aimed at, but it is not true that perfect mastery is often achieved.

Metal work is naturally divided into two grand departments by the use of heat as an agent for rendering metals ductile and plastic. A high temperature temporarily transforms steel and wrought iron. It greatly reduces the limit of elasticity; it reduces the tensile strength, and increases the ductility. At a white-heat, iron and steel *flow* under pressure like thick paste, and two parts will coalesce and form what is known as a "*weld*." Steel at a low heat if suddenly chilled becomes intensely hard. This hardening process is called "*tempering*." These facts lie at the base of the principal work in the forging shop.

Each workman has while in the shop the exclusive use of a forge, anvil, and kit of tools. As a rule this kit of tools comprises a hammer (quite unlike the wood-working hammer), four pairs of tongs, a poker, a rake, a shovel, a sprinkler, a chisel (to be set in the anvil, edge uppermost), and a steel square. There should be a sledge for every pair of forges. The student should remove his linen shirt in the dressing-room, put on a blouse and overalls, and wear a leather apron. The work is generally dirty, and the worker should be free to forget his dress and hands.

The operations of the forging shop involve a personal knowledge of three things:—

1. How to heat the piece to be operated upon.
2. How to hold it.
3. How to strike it.

In accordance with strict educational methods, we analyze the operations, give opportunity to acquire the three kinds of knowledge, and teach the three arts separately.

I. *How to heat.* The management of the fire so as to secure any desired degree of heat; to have one point of the piece hot and all others cool; to keep the piece under treatment clean; to save fuel; and to know just the degree of heat necessary for each operation—these are things slowly learned, but they must be learned well.

II. *How to hold.* As a rule this is the work of the left hand. It involves an intimate acquaintance with hammer and anvil; a knowledge of the behaviour of metals at different temperatures under the hammer; and a knowledge of what can and what cannot be done with metals through the agency of heat and pressure.

III. *How to strike.* Here the right hand and arm, wrist, elbow, and shoulder come into full play.[1] Strength and reliability are essential to force and accuracy. The pupil must learn how to grasp his hammer, how to swing it, and how to deliver blows.

[1] I am quite in favour of doing justice to the left hand and arm, and would encourage pupils to use either hand, but I would not delay the progress of the class on that account.

He must know the particular tools to be used; when to strike heavily, when lightly; when rapidly, when deliberately.

Precepts, examples, and trials are all necessary, and the teacher must, to a certain extent, teach these arts separately.

The worker at the anvil has, so far as the matter of forging is concerned, but a few processes to learn, though the number of ways and degrees in which they may be combined in practical work may be countless. With special combinations the manual training school has little to do; it is chiefly concerned with the fundamental principles. The processes may be classed as follows:—

1. *Drawing*, or making a piece longer. The effects of blows on the sides of a piece, thereby forcing out the ends, is similar to that of tension applied at the ends.

2. *Upsetting*, or making a piece shorter by blows upon the ends. This is just the reverse of "drawing."

3. *Shaping*, or changing the *figure* of a cross section without changing its area. This operation combines Nos. 1 and 2.

4. *Bending*, using various shapes—round, square, and flat; the last is to be bent in two ways. This operation involves *stretching* and *compressing*, and, according to the quality of the metal, requires a special heat. In all these exercises the student must learn to work rapidly when the iron is hot, and to stop the moment the temperature has fallen too far.

5. *Punching, cutting, and breaking.* These operations depend on the nature of the material and on the degree of heat.

6. *Welding*, uniting two pieces by forcing the fibres to intermingle at a high temperature. This requires a nice adjustment of the heat in the two parts at the same instant, and their superposition with clean surfaces. Generally two people are necessary in making a weld, and each may use his hammer. The welding of two pieces should be preceded by the welding of the parts of a bent piece, where no helper is needed.

7. *Hardening and tempering steel.* There are endless varieties of temper for different grades of steel. A great deal may be learned from lectures and a judicious series of exercises.

We have found it exceedingly profitable to teach the two arts, holding and striking, by means of a preliminary exercise in soft metal, generally lead, which is wrought cold. Just how to hold and how to strike depends upon the form to be produced, and it is of the utmost importance that that form be clearly in the mind of the young artist.

The teacher first gives drawings of the required piece, with all necessary dimensions. He next names the tools to be used and the order in which the steps are to be taken. (This order is much more important than it was in wood-work the first year.) He then takes the steps himself, calling attention at the same time to his manner of holding and of striking. His piece is compared with the drawings.

and should fairly embody the required dimensions. The teacher should always do his best work in the presence of the class.

One of the anvils should be so placed that one or two semicircles of temporary seats may be ranged round, so that each pupil may see and hear all that is done and said.

In following the teacher's lead, the pupils will have a clearly-marked course before them, but it will be found that much deliberation will still be necessary. A hasty blow, or a wrong motion to the piece, results in malformation or serious injury. Hence the pupil must think the matter out, and strike only when his mind has correctly analyzed the problem, and foreseen the results.

This shows the advantage of cold lead over hot iron: with the one, the mind may take time to reason out the how and the where; with the other, he must "strike while the iron is hot," though with fatal indirection. If one stops to think, the iron cools, and then it breaks from being worked at a low temperature; or it must be reheated, at the expense of time, and a surface layer of material which may leave the piece scant. We have found that the use of lead has been economical in three ways. It saves time in the end; it saves material (the lead is melted over into new bars with little loss); and it secures more accurate workmanship, inasmuch as the exact form is better understood.

It frequently happens, even in light work, that a heavy hammer must be used. A heavy hammer

moving slowly, is a very different thing from a light hammer moving rapidly, even when they have the same momentum ; one may tear the fibre, while the other does not. This may be admirably illustrated by upsetting the hot end of a rod which is held in the hand. With a light hammer and a quick blow the upset is all at the extreme end ; with a heavier hammer and a slower blow the upset is distributed for some distance; with a very heavy hammer and the same momentum nothing may be accomplished. In a general way, our young workman must test this point, and know when to call the aid of another student, either to swing the sledge or to hold while he wields the sledge himself. Two or even three strikers on one piece may at times work to advantage.

It is customary to give to forge work a maximum of 150 hours, less the time spent in dressing and washing. As the daily allowance is usually two hours, not more than $1\frac{3}{4}$ hours per day of work is possible.

The variety and quality of work accomplished during this time by boys of about $16\frac{1}{2}$ years is remarkable. The work seldom fails to interest and inspire the workers. The consciousness that not strength, but good judgment and skill, close attention and patience, are the price of success is encouraging to all good students. Careless and impatient boys either fail badly, or learn a lesson of infinite moral as well as intellectual value.

I can only give a few specimens of the exercises.

Fig. 14 is an example in bending. Besides giving fine practice in producing a uniform and a reverse

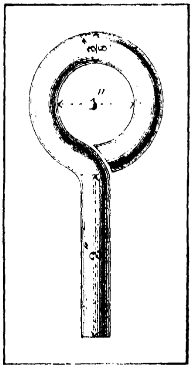


FIG. 14.—BENDING IN A CIRCLE RING-HANDLE.

bend, it teaches the length of bends. Though very simple on paper, an attempt to produce it is certain to develop many new ideas.

Fig. 15 represents an upsetting exercise. The "stock," or material, with which the student starts is

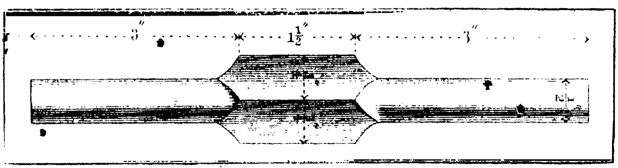


FIG. 15.—AN UPSETTING EXERCISE.

a round rod $6\frac{1}{2}$ inches long, and three-fourths of an inch in diameter. The piece to be produced is $7\frac{1}{2}$ inches long, and though the ends are smaller. the

centre proportion is to be three-fourths of an inch square. It is evident that the size of the rod in the centre must be increased. The operation is called "upsetting." It is executed as follows: The piece is heated almost to a white heat in the centre, while the ends are kept as cool as possible; they are plunged into water as soon as the piece is taken from the fire, leaving the centre still very hot. The rod is then made to stand on the face of the anvil while the top is struck heavily with the hammer. If the blow is

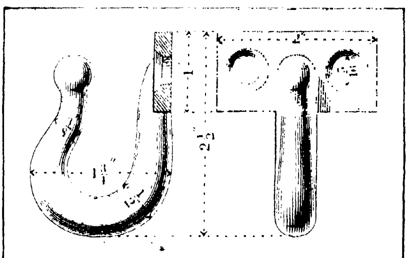


FIG. 16.—A DRAWING EXERCISE—HOOK HANGER.

true, the rod shortens and thickens at the hot centre After a few blows the rod generally is badly bent. It must then be straightened, reheated, and the upsetting continued till the centre is enlarged to the proper size. What that proper size is (so as to be three-fourths of an inch square when finished) is one of the important things to be learned.

The "stock" for Fig. 16 is from a 1 inch by $1\frac{1}{2}$ inch bar. This exercise should first be executed in lead. The length of the hook is always a surprise.

The art of welding is highly important, and is the subject of several very practical talks. The construction of these links of a chain (Fig. 17) is the first

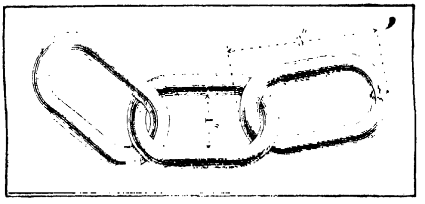


FIG. 17.—WELDING CHAIN-LINKS.

attempt at welding, and a great many points are to be noted. Above all, the fire is to be kept clean and in a good condition.

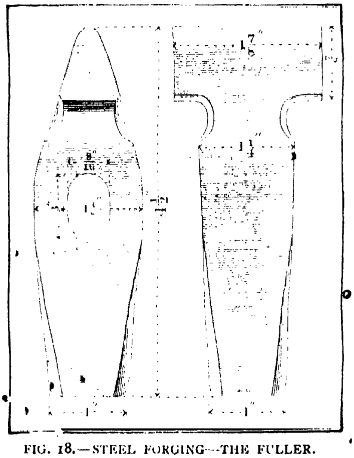


FIG. 18.—STEEL FORGING—THE FULLER.

Like several of the exercises which precede that

shown in Fig. 18, the material to be used is steel, cut from a bar $1\frac{1}{4}$ inches square. It is to be carefully heated and worked with heavy hammers. The operation of punching and shaping the hole is a very difficult one for a learner. This exercise is No. 37 in the series, so that the reader can see that it has been gradually lead up to. The student learns tempering while forging and tempering a set of steel lathe-tools for his own use in the shop next year. As a preliminary to tempering tools the student should prepare a series of small specimens tempered to different degrees of hardness.

I propose to close this imperfect sketch of what is done in a forging shop by what, perhaps, I ought to have given at the beginning. It is no small accomplishment to know how to weld and manage a fire for forging. I shall therefore give an almost verbatim specimen of class instruction from one of our shop teachers.[1]

Imagine him at his forge in the centre of a semicircle of interested boys, no one of whom has yet had an iron in the fire. As the instruction begins and goes on, imagine him "suiting the action to the word" with a force and fitness which Hamlet never dreamed of. In fact, the eager eyes of the boys follow what he does as their ears drink in what he says. In the course of his short lecture he shows them just how to do it, as well as how not to do it. Now listen and watch him :—

[1] Mr. Charles E. Jones, St. Louis Manual Training School.

"Before lighting the fire I wish to call your attention to the blast orifice, also to the blast gate, and to explain how to use it. I shall also give you a few hints upon the care and management of the fire.

"In the first place, notice the position of the blast opening relative to the forge, for it is immediately over the blast opening that the fire is hottest; it is at this point we wish to place the work to be heated, that is, some three or four inches above and immediately over the blast-opening.

"[Here Mr. Jones places the kindling and coals, and lights the fire. He turns on a proper blast, and soon has a mass of glowing coals.] It will be readily seen that to heat the work we must have some fuel between the work and the jet of air that is urging the fire. Hence we must not put the iron too low, not only because the point I have named is probably the hottest part of the fire, but because, as the fuel burns away, the cinder, in a liquid state, is gradually settling to the bottom of the shallow pit in which the fire is built; and if the work is put too low in the fire, it becomes coated with this semi-vitreous mass which when worked on the anvil is driven into the surface of the iron. When this is cooled it contracts and scales off, leaving the surface of the iron deeply pitted with the appearance of being rust-eaten.

"The fire should be kept as small as will possibly heat the work in hand; in our case say from four to six inches in diameter. This is accomplished partly by packing the coal as hard as possible around the desired size of fire, and partly by frequently sprinkling around the fire with water whenever it shows signs of spreading. This packing of coals around the fire also prevents in a measure a wide disturbance of the fire whenever the work is thrust into it. Some disturbance cannot be avoided, consequently the fire should always be repaired when this happens, care being taken not to throw in the green coal first, but those portions that are the hottest; this is important, particularly as the work approaches a high temperature —a welding heat, for instance. At such a time the thrusting in of cold fuel cools the fire and sets back the heat. In these forges the size of the fire is in part regulated by the ring of fire bricks which forms a sort of fire-pot two or three inches deep. In no case must these bricks be loosened or disturbed.

"In this connection the blast also plays an important part. Greater force should be given towards the end of the heating, except in case of small work, where a uniform amount of blast is given, graded as nicely as possible to the size of the fire. If too much blast is given and the fire is nice and clean, the burning coals are scattered over the hearth; in fact, this frequently happens, particularly just after the fire has been cleaned of the cinder.

"Sufficient coal should always be kept on the forge to keep up the embankment, or backing, previously spoken of, the coal to replenish the fire being drawn up from the edges nearest the fire with the rake or shovel.

"I should also explain that, as the blower furnishes a uniform pressure of blast, the way to control the blast to suit the size of fire is by giving the blast-gate a greater or less opening: this, after a few hours' practice, is generally pretty well understood. To keep the fire reasonably small is much more difficult. When told to sprinkle it you will often overdo it to such an extent as to put out the fire at the bottom, leaving only a layer of live coals on the surface; you will then be surprised that your iron does not heat, but it will be no longer a mystery when the surface coals are removed and it is seen that the work lies embedded in damp ashes only. I must hear explain that the only means we have of ascertaining when the work is of the proper heat, is by withdrawing it from the fire and looking at it, quickly replacing it if not of the proper heat. When it is withdrawn, you should notice if it is being heated at the proper place; if it is not, then push farther in, or not so far, as the case may be, for it frequently happens that the cinder obstructs or deflects the blast in such a manner that the hottest part of the fire is not where we naturally look for it, viz., immediately over the tweer opening. You must therefore keep your eyes open and your wits about you all the while.

"I shall teach you the several degrees of heat we shall need, and how to recognize them as our exercises proceed.

"From what I have said and from what you would naturally expect, we shall look for the cinder in the bottom of the fire-pot, the hottest coals next above, and the half incandescent coals on the surface. These positions suggest the method of cleaning the fire. By cleaning the fire I mean removing the

cinder which is a mass of ashes and incombustible material always found more or less in coal. This refuse melts partially and cakes into layers which must be removed every hour or two so as to leave the fire clean. When done at all the cleaning should be thoroughly done, as follows: --

"First rake away the half-incandescent coal into a pile by itself. Next, draw the fully glowing incandescent coals into a second pile just beyond the edge of the fire-pot. Now with the shovel quickly cut out the layer of cinder and throw it on the cinder pile under the forge. Then carefully draw back the live coals into the fire-pot, keeping them together as much as possible. Next, draw over and around them the half-burning coals and put on the blast. Green coals may now be packed around and sprinkled. In a moment you have a clean and hot fire."

The reader must bear in mind that while thus describing the process Mr. Jones is actually going through it in a skilful and efficient manner. But not that alone: the next step is for every boy to go to his individual forge and go through the same operations himself under the teacher's eye. A single glance tells the expert whether his instructions and example are being followed or not, and a few extra words and motions suffice to set right a boy who has forgotten or who has not understood. No boy fails to be interested and attentive, though some fail to comprehend the first time.

Fulness of explanation and illustration is not peculiar to this exercise; it is characteristic of every exercise. *Ab uno disce omnes.*

CHAPTER IX.

BENCH AND MACHINE-TOOL WORK ON METALS.

THE second grand division of metal work differs widely from the first. Here the properties of the materials are not changed by heat, as they were at the forge. Here cast metals as well as rolled metals are used, and all are wrought cold. The tools are new, and new theories are involved. Here metals are to be cut with a chisel, planed, turned into a lathe, bored, filed, and polished. Great precision is possible, and nice measurements are demanded. At the forge the degree of precision expected is well expressed by the proverb that a blacksmith's "hair" is a quarter of an inch in thickness. In the new shop the student quickly learns to see the difference between a thirty-second and a sixty-fourth of an inch.

The shop equipment for the work of this year, which should be the last year of the Manual Training School, is by far the most elaborate and expensive of all the school apparatus. Many schools must be content with a bench outfit and a few machine tools. The kind of tools which are regarded as typical in character are:

The machinist's vice, heavy and strong.

The machinist's hammer, cold chisel, and set of files.

The screw-cutting lathe, the speed lathe, the planer, the shaper, the drill-press, two emery wheels (one coarse and dry, the other fine and wet), and a gas forge.

The student is supposed to have a complete set of lathe tools of his own manufacture, made according to the best models, and tempered; they are now to be ground to correct angles. These tools become dulled and worn by use, and frequent dressings and retemperings are necessary. For this work, the gas forge, with its anvil outfit, is necessary. This feature is not found in commercial shops, but no school instruction-shop can reach its full measure of success without it. No teacher can afford to have his pupils wait for others to dress their tools, nor should he send them to another shop to do it by themselves.

I shall not attempt to give an analysis of the work done with bench and machine tools. It is highly intellectual, requiring deliberation and close attention. With careful instruction (which should always be given in the form of lectures upon the several functions of the tools, and fully illustrated by the teacher himself while his students are attentively listening and watching), the students avoid serious mistakes, breaks, and accidents. Matters of speed, strength, friction, must be learned by trial as well as by precept and example. No one knows how to perform a delicate operation, in a shop or anywhere else, till he has learned it by actual experience, and it is only after several trials that he can have any just appreciation of another's skill.

In this shop, as in all others, the chief effort should be to master principles and processes. Until the alphabet of such work has been learned it is of little value to be striving ambitiously to coin words. The expert teacher should reflect upon the peculiar character of the work that can be done in connection with each tool, and analyze it carefully into steps or parts. Then he should decide upon the order in which those steps or parts can be logically presented and mastered one by one. Then, finally, he should design a series of simple exercises whose sole purpose is to afford opportunities for learning the processes and mastering the tools.

He will probably learn by experience that every exercise to precise measurements should have a preliminary exercise, in which quality, not quantity, is aimed at, and on which the pupil learns how things behave and where dangers and difficulties lie. My shop teacher, a very expert mechanic, with an experience of nine years in this work, finds that a series of some twelve exercises, with their uncounted preliminaries, is sufficient for becoming reasonably familiar with all the tools. I say "familiar," not skilful. A high degree of skill, with its element of speed, as well as accuracy, is beyond the range of school work.

I give but three of the exercise drawings, with the caution that the drawings give but a faint idea of what there is in the real work.

The "stock" for fig. 19 consists of a piece of round iron, or steel rod, $6\frac{1}{4}$ inches long, and one inch in

diameter. The rough stock is not supposed to be cut squarely or to exact dimensions. The preliminary steps of centering, drilling, and counter-sinking, the lathe bearings, squaring, &c., form important parts of the exercises. The dimensions shown are

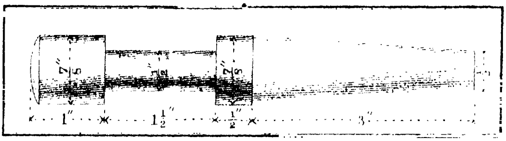


FIG. 19.—TURNING WROUGHT IRON.

to be realized to within one sixty-fourth of an inch The chambered part is to have square corners, and the head is to be turned spherical. The taper is to be turned in the lathe by first calculating how much the "tail-stock" is to be drawn over, and then turning till the required diameter of the small end is reached. The taper is to be "draw-filed," and all the rest highly polished.

Fig. 20 represents one of the set of three handles

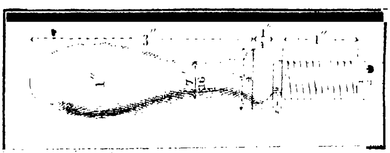


FIG. 20.—HAND-TOOLING STEEL HANDLE.

which are supposed to be made just alike. The stock is $1\frac{3}{8}$ inch rod, $4\frac{3}{8}$ inches long. The material is wrought iron or mild steel. The handle is approximately

formed, and the thread of the screw is cut in the engine lathe. Next, in the speed-lathe, by the use of hand-held tools, the free outline of the handle is obtained and the main portion is given a high polish. The thread is of standard description, so that the handle might replace one on the lathe itself. The "points" in this exercise are the standard thread and the free-hand work on the body of the piece. The element of beauty as allied to use appears in the exercise.

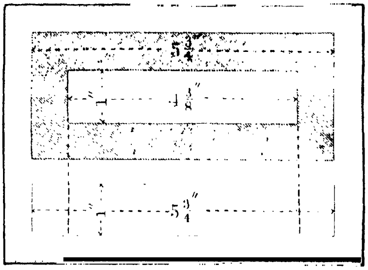


FIG. 21.—CAST IRON: PLAINING, DRILLING, AND FILING.

Fig. 21 shows an exercise involving many tools and processes. The accuracy of angles is an important point here, as well as the use of hand tools. The stock is a rough block of cast iron. The exercise involves planing, drilling, chipping, and filing. In connection with each of these steps, the student must learn how the piece is to be held or supported. All angles are to be exact right angles. The hole or slot is bored, chipped, filed, and polished. It is, of course, difficult to produce a fairly perfect piece, but

the nature of the work is such as arouses the liveliest interest.

When the regular exercises are finished, a synthetic exercise may properly be introduced, not so much for the finished machine or apparatus as to show the student himself just how much he has learned. He will find, on the one hand, that all complex operations may be analyzed into comparatively simple steps, and the chances are that all the steps will appear not only possible but easy. On the other hand, he will find that his design, as he has it on paper or in his mind, is very imperfect; that many details are wanting, and that some of them are difficult to obtain. He will find when he goes to his lathe, planer, or drill that there is much in connection with those tools which he has never learned, and his admiration for an expert who is never at a loss rises to a higher pitch.

With the advice and help of his teacher he succeeds in constructing a steam-engine that will go, a dynamo that will produce a current, a pump that will work, or a speed-lathe that will run fairly well; but he has done something far more important than either of those things: he has seen how much he does not know and cannot do, that others, whose garments may be greasy and whose hands may be hard and soiled *do* know and *can* do; and he has seen something of the relation which exists between a thought in the mind, and its realization in iron and steel.

If now we cast a look of review over the whole field of manual training, with its analysis and syn-

thesis; its range of materials, its variety of methods, and its typical tools, we may catch some idea of what the student has gained. The world is still all before him where to choose, but he knows somewhat of its deeps and its shallows, its hills and its valleys. With some culture of mind and some skill of hand (or if you please, some skill of mind and some culture of hand), he is not wholly unfitted to choose. He had caught a glimpse of vast spheres of human activity; he has opened the doors of a hundred busy shops where the secrets of our industrial civilization lie revealed to one who is able to read them, How many of these secrets he has read or can read it may be rash to say, for the language in which they are written does not come with equal facility to all. If he has enjoyed his course of study and training (and nine out of ten do enjoy it heartily), he possesses a sturdy manliness, a clear mind, a hearty relish for both mental and physical activity, and a strong, healthy sympathy with men possessing practical skill.

Let no one suppose that the work I have briefly described has a sordid or debasing influence. Its effect is wholesome and ennobling to the character and tastes. It is manly to feel strong and capable of grasping with the problems of life. I cannot imagine a young man with a sound mind in a sound body, no matter how highly cultivated he may be on spiritual and ideal lines, who would not be strengthened and enriched by this manual training. I am not assuming that he is to have something to do with

mechanical work, nor that he is not. He may be a mechanic or he may be an engineer; he may be a merchant or he may be a manufacturer; he may devote himself to law or to leisure—in any event he will be more of a man for his human culture.

CHAPTER X.

THE FRUITS OF MANUAL TRAINING IN EDUCATION.

THE value of manual training when properly combined with literary, scientific, and mathematical studies is shown in various ways.

I do not find it easy to classify these fruits under such heads as economic, mental, and moral; for a benefit conferred may fall under two or even all three heads. I will, however, adopt a certain order. I speak of manual training as a feature of the higher grades, and within the reach of all boys. It bears fruit only in proportion to its adoption.

1. *It keeps boys longer at school.* This result is very quickly noticed and fully appreciated. One superintendent says: "Manual training has increased the attendance of boys in the high school fully 33 per cent."

Another, speaking also of the high school, says: "Of the seventy-nine boys who took manual training last year, seventy-five remained in school to the close of the year. This is a remarkable fact in the history of our city schools."

A high-school teacher says that "the efficacy of manual training is shown by the unusual attendance of boys. More boys graduate this year than ever before in the history of the school."

' Every one knows how classes of boys diminish as they approach and pass through the high school. I have already referred to the withdrawal through lack of interest. The superintendent of a large city says that of 108 pupils (boys and girls) entering the primary school only *twenty* finish the grammar, *four* are found in the second class of the high, and *one graduates*. For boys alone the showing would be worse. Not one-half of those who finish the grammar enter the high, and not 20 per cent. of those who enter complete the course.

Several hundred pupils have entered the St. Louis Manual Training School. A large proportion of these would not have gone to school elsewhere, I am certain, and yet 50 per cent. of them complete the course.

During the past year we have had many more applications of competent boys than we had places The two lower classes have both been at a maximum throughout the year.

The Director of the Chicago Manual Training School (just completing its seventh year) says that while boys, who enter the high school with an expectation of taking the full course drop out rapidly, many of them during the first year, the manual training schools which admit only boys remain crowded. Speaking of his own school, he says;

" It is less than the truth to say that the number applying for admission is double the number that can be admitted. Most of the applicants come from the grammar schools, having been admitted to the high

schools. As many as 20 per cent. of some of our classes have spent a year or more in the high schools, and enter the manual training school, beginning with the first year. The parents of many of these boys are in very moderate circumstances, yet they prefer to pay a tuition fee of $100 a year rather than to accept for their sons the free tuition of the high schools. Nor do these boys seek the manual training school in order to escape mental toil. In addition to three hours' daily work in drawing-room and shop, they each have three daily lessons in the severer high-school studies. The school hours are longer than in the regular high school, extending from 9 a.m. to 3.45 p.m., and yet most of the preparation for their academic work must be done at home ; so that the manual training schoolboy's day is filled with work.

"*But he likes the work : he sticks to it ; and advises his friends to come.*"

He (Dr. H. H. Belfield) then adds that a free manual training school under the management of the School Board would "satisfy the wants of many people, and would solve the questions, how to get the boys into the high school, and how to *keep them there.*"

The unparalleled attendance of mature boys at the Philadelphia and Baltimore Manual Training Schools (both are free city schools) without diminishing the attendance elsewhere, shows that this first-fruit of continuance in school is a very important one. When schools are no longer "profoundly and inevitably un-

interesting," but alive and aglow with interest, boys will come and stay.

2. *It awakens a lively interest in school, and invests dull subjects with new life.* This is akin to the first point. "My son never was so interested in his school, never studied so hard, and never had so much to tell about school work as now." That is the way scores of parents have reported. "My son got his start and taste for study in the manual training school." The habit of applying what one reads or hears to what one does, makes things interesting.

3. *It keeps boys out of mischief both in and out of school.* This result is most marked. I am a teacher of wide experience, in schools classical, semi-classical, and scientific, besides ten years director of the manual. I have never seen a school so easy to manage as the manual training school. The pupils are so earnest, so impressed with the value of what they are receiving, that mischief and foolishness seems rather out of place. Fellow principals in other cities bear the same testimony. One says, that the moral influence of manual training, as evidenced in the school itself, is worth all the manual training costs.

Out of school hours, its influence is equally marked. Parents report that the school interests affect the boy's choice of recreations. The student generally has an auxiliary laboratory at home where he spends a good share of his spare time. The boy's mind as well as his hand is occupied, and Satan finds it hard to gain a listening ear or an idle hand. Yesterday (April 30, 1890) a petition was handed me, signed by

some twenty members of our highest class, asking that the engine be run on Saturdays, and that they be permitted to work in the shop on those days. It would seem extravagant for me to claim that my boys are too busy to be hatching up mischief, yet I think that is a statement of a fact. Read the opening paragraph of Chapter XIII., and see what a mother says.

Here is a bit of testimony from a distant city that is very much to the point. I quote from an editorial in the *Boston Herald* of March 16, 1890, on the Influence of the Cambridge Manual Training School, now in full operation during its second year:

"The whole boy is put under subjection to discipline—not his intellect alone, not his hand alone, but the mind, the hand and the will in combined action. From a knowledge of the kind of boys here brought together, it is easily seen that this school is solving in part a great social question. The difficulty in a great city like Cambridge is to know what to do with the boy who is growing up into manhood. He does not have so good a chance as the youth on the farm, and he cannot turn his hand to useful employment so easily as he could in a city presenting the opportunities which are found in Boston. The tendency of such youth is to fall into bad ways, and to go from bad to worse. While the Cambridge Manual Training School does not deal with a single class of boys, it has brought within its scope a large number of youths who were without occupation, ambition, or enthusiasm. These boys have been really re-made. All they wanted was something that interested them. . . . The transformation that has been reached in some of the wild Cambridge boys, by their stay of one or two years in this school of industry, has been a marvel and a joy to their parents and friends."

4. *It gives boys with strong mechanical aptitudes, but*

who are slow of speech, an equal chance with boys with glib tongues and good memories.

What we call scholarship and rank is based on success in all the five features of the programme. Shopwork and drawing count equally with mathematics, science, and literature. A boy who cannot do well on some of these lines must be mentally deficient. Few boys can at the start do equally well in all, but success in shop and drawing (and here good judgment, close observation, and a firm hand avail more than fluent speech) has often the effect of arousing ambition and awakening dormant powers. I have seen boys almost made anew by the realization that they were not dunces after all, and that there was more than one criterion of success.

Perhaps a majority of healthy boys are so constituted that their controlling interests are not in the study of words, the forms of speech, or the boundless mass of information which is given in books; and I would give such boys a fair charce of adequate development. Such boys are not necessarily blockheads, nor even dull. Their intellectual powers may be strong, though their strength lies not in the direction of memory. The claims of this class of boys have been set forth by no one so eloquently as by Gen. Francis A. Walker. He says, and I give almost his exact words: "There is now no place, or only a most uncomfortable one, for those boys who are strong in perception, apt in manipulation, and correct in the interpretation of phenomena, but who are not good at memorizing, or rehearsing the opinions and

statements of others; or who, by their diffidence or slowness of speech, are unfitted for ordinary intellectual gymnastics. These boys are quite as numerous as the other sort, and are quite as deserving of sympathy and respect, beside being rather better qualified to become of use in the industrial and social order. And yet for this class of boys the school offers almost nothing upon which they can employ their priceless powers. They may, by labouring very painfully over the prescribed but uncongenial exercises, escape the stigma of being blockheads; but they can never do very well in them. They will always appear to disadvantage when compared with the boys with good memories for words, whose mental and moral natures accept with pleasure or without serious question the statements and conclusions of others. Such boys are practically ploughed under in our schools, as not worth harvesting. And yet it not infrequently happens that the boy who is regarded as dull because he cannot master an artificial system of grammatical analysis, who isn't worth a cent for giving a list of the kings of England, who doesn't know and doesn't care what are the principal productions of Borneo,—has a better pair of eyes, a better pair of hands, a better judgment, and, even by the standards of the merchant, the manufacturer, and the railroad president, a better head than his master."

Now the manual training school proposes to cultivate and harvest both kinds of boys.

As Col. Jacobson says, "Manual training means not fewer, but more, ladies and gentlemen to the acre."

One of our most successful graduates was so fearfully slow of speech that his teachers often refused to wait for him to answer an easy question. He often appeared extremely dull, but I suspect that he was really weighing different forms of answers as they rose to his lips. Lack of training left him powerless to make a quick decision or choice. He is number twenty-eight in the list of those reporting progress in Chapter XI. He is no longer regarded as slow of speech.

5. Manual training stimulates a *love for truth, simplicity*, and *intellectual honesty*. The comparative worthlessness of inaccuracy, of a want of agreement between the thought and the deed that was to realize the thought, is made as manifest as sunlight. If a fitting is not true; if a device is not just what it seems to be—it is a failure and a sham, and the boy learns to rate them as such. Professor Eggleston says that the boy who learns to despise "work out of truth," who will not "tell a lie in wood," will by necessary and unconscious process of reasoning despise in a greater degree a lie in words. Simplicity is the greatest possible merit in a mechanical device or process. Everything must be direct, straight-forward, with the least noise, and a minimum waste of effort. A high appreciation of this quality in manual his[illegible]k cannot but tend towards a similar quality in chamost u[illegible]sation, and life. In like manner honesty strong in persion in deed as much as in word. The in the interpreta unchanging laws of physics and good at memorizing bribe and connive at no decep-

tion. The pupil is stimulated to love and respect honesty, not by resisting, but by seeing that dishonesty is a sign of weakness and incompetency.

6. *Correct notions* of *things*, *relations*, and *forces*, derived from actual personal experience, go far towards a comprehension of the language employed by others to express their thoughts and experiences.

Correct use of language depends not so much upon what one has read as upon the extent of his intercourse with correctly speaking people. Nearly all our forcible words are derived from the physical world, where they cannot be defined by other words, but must be felt and experienced to be known. In this respect the activities of the shop serve to supplement the science laboratories, nature, and art. Among all these the industrial interests are not to be overlooked.

7. Science and mathematics profit from a better understanding of *forms*, *materials*, and *processes*, and from the readiness with which their principles may be illustrated.

This advantage is very noticeable to teachers. Definitions are quickly grasped by shop-workers, and geometrical constructions are easily seen.

In devising and constructing apparatus, manual training is invaluable. I have seen hundreds of well-made, serviceable pieces made by students to illustrate the various departments of physics. Hydraulics, hydrostatics, pneumatics, acoustics, heat, light, electricity, and magnetism are best taught by beginning with school-made and then school-used apparatus.

Nothing so stimulates an interest in physics as laboratory work, and without some manual training the best part of laboratory work is almost impossible. The ability to think out a piece of apparatus, make a scale drawing of it, showing all details, including joints and methods of support, and then to construct it in proper material, is exceedingly valuable. Chemistry is somewhat dependent upon manual skill, though to a less extent than physics.

Passing now beyond the school, I come to its fruits outside.

8. It aids one who must *choose his occupation*.

Most children step from the schoolroom into the working world with no just conception of what the world is nor what it is doing. In a great majority of cases one's occupation is the result of chance or environment. There is no intelligent choice, because there is no intelligence in such matters. Boys who live near the wharves become sailors ; the son of the schoolmaster teaches school, &c. If they break away from the influences that would thus hedge them in they are apt to take their chances with the odds against them. It is more than likely that the square plug gets into the round hole. To change the figure, the boy fresh from school, sees a variety of roads before him. How is he to know which to choose unless he knows not only the roads, but himself? Clearly, intelligent choice can be exercised only when the chief characteristics of both roads and traveller are fairly comprehended. Education, then, must be "all around," and many-sided, unless the right of choice is

denied. On this point I think we can all agree. But now comes the question: How much of this must a school undertake, and how much must be left to the home and other influences? Here we shall differ. One points to the past, and says, "thus did our fathers, and so must we;" as though we, who refuse to do other things as our fathers did them, and persist in doing a thousand things which our fathers never dreamed of, must still conduct school education in the old-fashioned way. To speak truly, it is as absurd to consult Plato, or Cicero, or Milton, or Samuel Johnson, or Benjamin Franklin, or Daniel Webster as to how we shall teach school in this year of our Lord, 1890, as it would be to consult them as to how we shall build our houses, cultivate our crops, fight our battles, travel over land and sea, communicate our thoughts, light our streets, or amuse our children.

It occasionally happens that the student who has special aptitudes in certain directions finds great difficulty in mastering subjects in other directions. In such cases it is often the best course to yield to natural tastes, and to assist the student in finding his proper sphere of work and study. A decided aptitude for handicraft is sometimes coupled with a strong aversion to and unfitness for literary work which largely taxes the memory. There can be no doubt that, in such cases, more time should be spent in the laboratory, and less in the library and recitation room. On the other hand, great facility in the acquisition and use of language is often accompanied by a great

lack of mechanical interest or power. When such a bias is discovered, the lad should unquestionably be sent to his grammar and dictionary rather than to the laboratory or drafting-room. It is confidently believed that the developments of the manual training school will prevent those serious errors in the choice of a vocation which often prove so fatal to the fondest hopes.

It is highly desirable that a larger proportion of intelligent and well-educated youth should devote their energies to manual pursuits or to the development of mechanical industries, both for their own sakes and for the sake of the occupations and for society.

Undoubtedly the common belief is, that it requires no great amount of brains or intelligence to be a mechanic; and those who go through ordinary higher schools are not expected by their teachers to be mechanics. Every bright farmer's boy, every gifted son of a mechanic, if he but stay in school, is sure to be stolen away from the occupation of his father and led into the ranks of the "learned professions."

This loss of the best minds, and the lack of the results of a generous education does much to give colour to popular prejudice, and to keep down mechanic arts in the estimation of all. This result is most unfortunate for society. It creates distinctions which ought not to exist, and gives rise to false estimates of the comparative value of the various kinds of intellectual culture.

Hitherto, men who have cultivated their minds have

neglected their hands; and those who have laboured with their hands have found no opportunity to generously cultivate their brains. The cyring demand to-day is for intellectual combined with manual training. It is this want that the Manual Training School aims to supply. Its motto is :—

"The cultured mind, the skilful hand."

9. It raises the *standards of attainment in mechanical occupations* and invest them with new dignity. Man became man when he made his first tool, and he becomes more manly as he continues to invent and use more tools.

Man subdues nature and develops art through the instrumentality of tools. To turn a crank, one needs only muscular power. But to devise and build the light engine, which, under the direction of a single intelligent master-spirit, shall lift the burden of a thousand men, requires a high degree of intelligence and manual skill.

There are now no hewers of wood or drawers of water. That menial work is now done by machinery. Even the streets are swept by horse power, and the best bricks are made without the touch of man's hands? Through the instrumentality of tools, the intellect is gradually doing away with the lower forms of labour. Every occupation becomes ennobled by the transforming influence of thought and skill. The farmer of old yoked his wife with his cow, and together they dragged the clumsy plough or trans-

ported the scanty harvest. Down to fifty years ago the life of a farmer was associated with unceasing, stupefying toil. What will it be when every farmer's boy is properly educated and trained? Farming is rapidly becoming a matter of horse-power, steam-power, and machinery. The farmer will rise in dignity when he is able to intelligently direct such appliances, and to manage them well.

Instead of preparing men to bear more cheerfully the drudgery of toil, we should enable them to overcome toil by a degree of skill which raises a trade to the rank of a profession. The profession of dentistry has developed from a mere trade by the use of scientific methods. When to the skill of the machinist we add drawing, mathematics, and science including theoretical mechanics, we have an accomplished mechanical engineer. A few days ago I met a graduate of a manual training school. We were both inspecting the massive machinery of a "power-house" of an electric railway. Said he, "When the manual boys go into mechanics they help the crafts. They bring education, intelligence, and habits of systematic study. They lift up the business and win a degree of respect that the old shop hands never got and never deserved."

What that young man said has wide application. Only a small part of the students can be expected to become mechanics, for their aptitudes and their opportunities will carry them in a great variety of ways, but wherever they go they are likely to come in contact with industrial work. If they are true

to their teachings they will affect all such work favourably.

The habit of working on an exact plan, of analyzing an apparently complicated operation into a series of simple steps, enables one to solve many a new problem, even with new material and under entirely novel circumstances.

10. It enables an employer of labour to better estimate the comparative value of skilled and unskilled labour, and to exercise a higher consideration for the labouring man.

Too often there is a great gulf between employer and *employé*; neither knows enough of the experiences of the other to furnish common standing ground; their educations have been on totally different planes. Give to the literary and scientific training of the one a fair allowance of manual training; and to the unscientific and narrow tool-work of the other something of letters, mathematics, science, and drawing, and the two understand each other at once. Says Mr. Edward Carpenter :—

> "Administrative work has to be done in a nation as well as productive work; but it must be done by men accustomed to manual labour, who have the healthy decision and primitive authentic judgment which come of that, else it cannot be done well. Above all things, have done with this ancient sham of fleeing from manual labour, of despising or pretending to despise it."

11. *It stimulates invention.* We are apt to fancy that the age of invention is nearly over. On the contrary, it has barely dawned. What has been done

in the past has been in spite of the education of the schools. The educated man so-called rarely makes a practical invention, so deficient is he in a knowledge of essential conditions. The practical mechanic rarely invents because he cannot calculate and cannot draw. Add to their educations the missing elements in either case, and you have advantage ground that to no great extent has ever been occupied. Already I have seen its fruits. One of our students invented a new tool that enabled him to double the amount of turning he could do in a day. Another invented a method of forcing water from a tank below the floor of a palace car to the faucets of the washstand. Another invented an automatic air brake for a street-car. And another has greatly improved the details of an electric plant —and all are yet boys. When manual training has been generally adopted for boys in their teens, the world will see a multiplication of useful inventions such as not even the past twenty-five years can parallel. The era of invention is now in its infancy.

12. It increases the *bread-winning* and *home-making power* of the average boy. The average boy has his bread to win and his home to make. It is of the utmost importance that his education should fit him for his work. Three out of four of the boys in a great city are practically thrown upon their own resources the moment they leave school. Their degree of preparation for life's work and duties is a matter of no small concern to themselves and to the State.

There is, there can be, no sort of doubt about the

ability and the disposition of this average boy to make and maintain a good home if he will secure a manual-training-school education with its full complement of studies.

Some think that this result would be achieved were he to remain in school long enough to take the ordinary studies of the manual school, with the manual training omitted.

Possibly, but a possibility becomes almost a certainty if the manual features are retained. There is plenty of evidence on this point, brief as our experience has been. The St. Louis Manual Training School has been in operation ten years. Over three hundred and thirty students have graduated, and as many more have taken more or less of the course. They are becoming fairly well known in the city, and their value is highly appreciated. As a rule, they are standing recommendations of the school, and living witnesses of its value. They are in great demand, and I cannot supply one-half as many as are needed by the various establishments of the city. I am requested to send a "graduate," and he is generally sought for the reason that he is able to use both his head and his hands. Such boys earn good wages, secure rapid promotion, and keep good positions. For further evidence on this point I refer my readers to the next Chapter.

13. It adds to the efficiency of school work by, *making school attractive;* by arousing the enthusiasm of pupils; by making the work more intelligible; by making pupils more manageable.

These results manifest themselves most clearly to the teachers who are in daily contact with the pupils. I have been witness of this kind of fruit from the beginning, and have not hesitated to speak of it; but cautious people have been prone to suspect that the colour of my glasses had much to do with the complexion of what I saw. But other teachers in other schools bear the same testimony. I could quote them at length if it were necessary. I shall, however, limit myself to some evidence presented by the superintendent and teachers of the City of Washington, D.C.

Manual training has been more thoroughly introduced into the schools of Washington than in any other American city. The credit for this is largely due to Supt. W. B. Powell, whose service in this field I am happy to recognize. I am glad to quote from his recent report, and though the extracts bear upon several of the points already discussed, I prefer to present their testimony all under this heading.

It appears that wood-work and drawing have been introduced into all the grammar schools (for the upper grades) and into all the high schools, for both white and coloured boys, and that needlework and, to some extent, cooking have been taught to the corresponding grades of girls. In the high schools metal-work and higher draughting have been introduced.

The superintendent asked the candid opinions of his teachers as to the value of the new features. He says: "All concede that no academic loss has been sustained; the majority agree that a positive, appre-

ciable gain has been made in the academic studies. The majority report increased love of school increased interest in all studies, better appreciation of what is taught and why it is taught, better understanding of the relation between what is taught and the affairs of life, and resulting therefrom, broader and more intelligent grasp, and constantly greater cheerfulness, and less disposition to consider the school as a place for tasks, and the teacher as a task-master. . . . We have found that manual training has changed the processes of teaching, and given the teacher a new and better purpose of instruction; has changed the process of learning, and given the pupil at every step in his work an intelligent and tangible purpose for such work."

I quote that brief summary of Supt. Powell's with great satisfaction. It is admirable. From the reports of his principals I quote a few words.

One sought reports from all his assistants, and requested estimates of the educational value of manual training. In their replies they were "remarkably unanimous" in the conviction that it "should occupy an important place in our course of study, and that its introduction has not in any way interferred with the school work; but, on the contrary, that it has proved the needed complement of such work." All report that "parents heartily endorse it." The class-method of instruction is strongly recommended as compared with individual instruction, which drives pupils into enforced idleness while waiting for the teacher.

Another says: "The feature of all the new work that has most attracted my notice is the marked cheerfulness with which it is attempted by the children—without exception, a cheerfulness which borders on enthusiasm, and renders the work of the teachers of those special branches most agreeable."

Another says after a year's experience: "In my opinion this is the grandest step forward that the public schools have ever made."

The principal of the Washington High School reports that "the success of this branch is manifest on all sides, and perhaps most of all in the earnestness and vigour with which it is pursued."

The principal of the High School for Coloured Youths quotes approvingly the following pointed paragraphs from an editorial in the *Washington Post*, under date of June 23, 1889:—

"Among the revelations of the Paris Exposition is one which will surprise most Americans. It is the comparatively circumscribed character of American education. Many will regard it as a curious fact that in exhibits showing the methods and results of school work, England and America are far in the rear of France.

"This is because England and America have longest adhered to the idea of a literary training as the sole purpose of school training. Taking the country at large this is the idea of education which still prevails in the vast majority of American schools. The English language and literature, and, if possible, the classical languages and literatures—these have constituted, and in the main still constitute, the American ideal of an education.

"Now, in France, Germany, and other countries, the idea of an exclusively literary education has become obsolete, because it was found to be partial, one-sided, and wholly

insufficient. In those countries growth in literary knowledge is accompanied and complemented, stage after stage, by a similar growth in industrial training, and the valuable results which this exposition makes manifest bear ample testimony to the superiority of that method.

"France is easily first, both as to the extent and quality of her educational exhibit. Here all the world may learn what schools can do for inventive, decorative, and constructive industry. It shows how every step of mind-training is constantly accompanied by the training of the eye and the hand throughout all the sciences and arts, and it explains quite easily how France has gained her pre-eminence in fine industrial arts, and her monopoly of those profitable products which depend on the skill and genius of the designer."[1]

14. The last fruit I shall name is that of *intelligent citizenship.*

I am aware that this will excite some surprise. The opponents, or rather the critics, of manual training are apt to assert with some emphasis that the object of public education is to produce a high grade

[1] If we assume, as I think we may, that there is much truth in the opinions of *The Post*, we must rate ourselves low in view of the following somewhat derogatory remarks of the late Inspector-General of Manual Training in France, Mons. A. Salicis. Reviewing their system of education as a whole, he says :—

"For many centuries there has been no great change in the education of those classes whose livelihood depends on the daily work of their hands. It would seem as though the book or the paper were the only things they would have to handle, and as though the pen were the sole tool they would have to make use of. Book, pen, and paper are put into the hands of children from their fifth to their thirteenth year, and they submit during all this time with passive indifference to being saturated with the one taste for literary things. Then, when they have been carefully perverted both intellectually and physically with respect to the future which awaits them, and when the gate of life finally stands wide open before them, they are calmly expected to enter it not only unarmed but wholly unprepared."

of citizenship, and they generally claim that the traditional course of study is well fitted to that end, while manual training, in so far as it enters into education, tends toward narrow selfishness and away from an interest in the commonwealth. On the contrary, I claim that the effects are more than likely to be transposed, and I am confident that longer experience will show that I am right.

There are several reasons for such a result. (*a*) People well versed in the principles which underlie the mechanical operations of a majority of our citizens are much more likely to take an intelligent interest in the people themselves, in their condition, and needs. Franklin said he had always noticed that "among workmen, good apprentices made good citizens." (*b*) They are more likely to discuss questions of public improvements with judgment. (*c*) They are less visionary, more matter of fact, and consequently better prepared to deal with actual people under actual conditions. Of course I am comparing manual training school pupils with those of other schools.

I know of no better index of the state of mind produced by the two kinds of training than that afforded by current graduating essays or orations. Whether the subjects are chosen or assigned by the teachers, it is evident that they indicate better than anything else can the general trend of thought, study, and interest. I give a list of subjects taken from our last Commencement Programme and also from the programme of one of our best literary schools.

MANUAL TRAINING SCHOOL ESSAYS.

Labour Strikes.
History of the Steam Engine.
Study of Nature.
Medical Profession.
Manufacture of Shot-guns.
Electric Railways.
Business Tact.
Evolution of the Cooking-stove.
The South.
Legal Profession.
Methods of Milling.
The Planer.
Exercise and Athletics.
Modern Applications of Electricity.
Success in Life.
Styles of Architecture.
Bridges.
Commerce of St. Louis.
Chrystal City Glass Works.
Engineering.
Present Monetary System of the United States.
Adam Bede.
Electric Light.
Ice-making Machinery.
Coal.
Manufacture of Gas.
Railway Problem.
Mines and Mining of Montana.
Evolution of Modern Vehicles.
Legal Profession.
Evolution of the Steam Engine.
Dentistry.
Labour and Machinery.
Banking in the United States.
St. Louis Clearing House.
Manufacture of Steel.
Electric Light.
Capt. John Ericsson.
The Cable System.
Conflicts of Labour and Capital.
Medical Profession.
History of Architecture.
Photography.
International Currency.
Building Materials.
Commercial Travellers.
American Magazine and Newspaper.

CLASSICAL COURSE ESSAYS.

The Coliseum.
The Greek Temple.
Mutability, &c.
Nihilism.
The Glory of Athens.
The Character of Napoleon, &c.

If this evidence is not conclusive of the point claimed, I venture to quote a few words from two of our most philosophical writers. "Dealing with things in the concrete rather than in the abstract gives to men clearer ideas of the nature of things, and the practical lines of human progress than seems to be obtainable by mere study of such things in the abstract. It may not be pleasant for us to acknowledge, nevertheless it seems to be the testimony of all past history, that the highly-educated classes have been more generally wrong upon questions affecting humanity at large than classes who have been trained to labour with their hands. Thus, in the history of England, Oxford and Cambridge have been wrong upon nearly every great public question: on Catholic Emancipation, on Public Education, on the Extension of the Suffrage, on the treatment of Dissenters, on the Corn Laws, on the Land Laws, and, in fact, on every question which has arisen during the progress of those great reforms which are now universally acknowledged to have been just and necessary."[1]

"The highest culture and self-conscious directive power may stand in the way of a needed reform. As a matter of fact, it always has fallen into this error, and is always doing it again."[2]

[1] Prof. Thomas G. Shearman.

[2] Dr. Wm. T. Harris, U.S. Commissioner of Education.

CHAPTER XI.

THE RECORD AND TESTIMONY OF GRADUATES.

I NOW propose to give the results of manual training as shown by the record of the graduates of the St. Louis Manual Training School. I am well aware that I am undertaking a dangerous task. In the first place, it is difficult, if not impossible, to tell what is and what is not the result of the manual features. In the second place, the testimony of graduates is liable to be biased in favour of the course they took, on the principle that one should speak well of the bridge that brought him over, even if it is a very poor bridge. This difficulty, however, is shared by all forms of education and all institutions; and as my graduates are not more prejudiced than the graduates of other schools, their testimony is not to be unduly discredited. In the third place, the time is all too short for full results to appear. I cannot point to a long list of worthies who date the beginnings of honourable careers with their training here. Our oldest graduates are still young. But I am willing to trust the future. Such testimony as I can give is submitted with confidence, and a desire to be both frank and fair.

I shall first give, as fully as I can, the present occu-

pations of those who have taken the full course of the school; this will show their positions in society Secondly, I shall give extracts from the letters I received in response to a letter of inquiry. And here let me add, that in all this I evidently put my best foot foremost. The unsuccessful graduates are not likely to answer my letter, and though it would be manifestly unfair to assume that those who have not responded have nothing favourable to report, it is unquestionably true that those who have not written would make on the average a poorer showing than that given below.

The number of graduates in seven classes is two hundred and eighty-four; of whom the number taking higher education is eighty-eight, and of these forty-six are still students.

Clerks (chiefly in banks, counting-rooms, railroad offices, and hardware houses)	50
Architects and draughtsmen	38
In business or in offices involving a knowledge of practical mechanism	37
Mechanics	33
Teachers	21
Professional engineers	17
In business not closely connected with manual training	15
Physicians or dentists	8
Farmers	8
Lawyers	5
Merchants	4
Musicians	2
Dead	2
Employment unknown	10

The following circular letter will be of interest :—

"DEAR SIR,—In a book soon to be published, I desire to give as fully as possible the statistics of the graduates of the Manual Training School for the purpose of showing (so far as such things can be shown at this time) the results of the training afforded by the school. No names will be used in my analysis of these statistics, so I hope you will write with the utmost frankness. I wish to get at the TRUTH both when it makes *against* our school and when it makes *for* it. If I quote from your letter I shall not give your name, though your classmates may be able to infer it.

"I wish to know :

"1. Your address and the precise nature of your present or prospective occupation ; and if employed, how you are classed on your employer's books.

"2. If employed, your present (or recent) wages per month or year.

"3. How your position and pay compare with those of other young men of your age in the same or similar establishments.

"4. What you now think of your training at this school ; its good points, its deficiencies, its advantages, and its disadvantages.

"5. Under what circumstances would you, or your parents, or your employer advise a young man to come to this school.

"6. What your employer or immediate superior thinks of the result of your school training ; as to general intelligence ; habits of promptness and precision ; as to skill of any kind ; as to ability to understand what is new, and to do as you are directed ; as to your ability to bear responsibility, and to direct others ; as to your ingenuity ; as to your defects and failings ; as to your manners and general habits. Would he be disposed or not to give the preference to a graduate of this school, were he in want of a new clerk, assistant, draughtsman, or apprentice workman, from eighteen to twenty years of age.

"I suggest that you answer the first five questions yourself in a carefully written letter to me, and that you then place this circular in the hands of that one who can best reply to questions 5 and 6.

"Wishing you the highest success, I remain your friend,

"C. M. WOODWARD, *Director*."

EXTRACTS FROM LETTERS.

I must quote sparingly from my long file of interesting letters. For convenience I will number them as I take them up.

No. 1. is engaged in mechanical work.

"Too high an estimate cannot be placed upon the value of the method, exactness, and confidence which the student acquires by studying and carefully working out step by step the progressive course of study and practice. . . . My parents, my employers, and I would all join in advising a young man under all circumstances to attend a manual training school."

No. 2 is himself, though still very young, a foreman of a large system of railway shops. I quote, not what he says of himself, but what he says of other boys in his employ.

"As an employer, I will say for several of the Manual Training School boys I have working for me, that *they will in one year accomplish as much as the ordinary boy* (who has not received the training the Manual Training School gives) *will in three*. For example, I have two boys working side by side, one from the school and the other an uneducated boy; the former has been working here nine months, while the latter has been here over three years; and to-day the boy from the school will do better, cleaner, neater, quicker work by far than the other boy. One boy learns the trade by imitation, while the other learns it by reason and study. The boy from the school is more precise and neat about his work, grasps a new idea more readily, looks upon new features of the business with greater intelligence, and is better able to direct others and to bear responsibilities. He has better command of language and can impart to others the ideas he wishes them to obtain. When a difficult point arises, the school boy will labour with it until he conquers it, while the other boy will study a while, then give it up. Were I to need a clerk, apprentice, or draughtsman, I would and do give the Manual Training School boys the preference, because I get much better results with less trouble."

No. 3 is a teacher of manual training.

"I believe that the course in your school, as it was when I was there, and as I suppose it is now, was more than what it claimed to be, and accomplished all its aims, as far as I can see. I know that it opened up more than one path for a future for me, in congenial pursuits where all was blank before."

No. 4. This is evidently a "cow-boy" of the better sort, and he writes from his ranch in Poncha Park.

"I have not regretted going to the Manual Training School, for it is helping me a good deal. The knowledge I derived in the blacksmith shop has stood me in good stead, for on the ranch we do all our own iron-work as well as wood-work. We have a blacksmith shop and do all our horse-shoeing, though we did not learn to shoe horses in the Manual Training School. I would advise any boy who does not intend taking a classical education to go to the Manual Training School. I think my parents would answer the same way. As to my employer, I don't suppose he gives it a thought one way or the other. Out here every one thinks of nothing but cattle."

No. 5 finds use for his training, though not a mechanic.

"Every day I am required to put into use some of the knowledge or methods learned in the shops, and I think I should be utterly at sea without that training. The third year, both in the schoolroom and the shops, is of course by far the most valuable, and is the culmination towards which the rest of the course tends. You cannot too strongly urge upon students the necessity of the graduating year."

No. 6, a student of the class of '84, at Lehigh University, writes that during the Sophomore year the only difference between the course in civil and that in mechanical engineering lay in the study of "surveying" by the former, and the study of the

"steam engine" by the latter. He took surveying as an "extra," and the steam engine as a "regular," and was the only student in a class of eighty-one who did so. At the end of the year his general standing was *twelfth* in a total of one hundred and thirty-one Sophomores, and *he stood first in both surveying and steam engine.* He attributes his success to his excellent preparation.

No. 7 is designer and head draughtsman, Pullman car-shops, St. Louis. I greatly prize his suggestions.

"The advantages of the school are inestimable. . . . I receive a higher rate of wages than other boys in the same establishment. I would recommend that more attention be paid [at school] to pen-shading of concave and convex, and ogee surfaces, and also to sections and details of all kinds, so that one of your graduates may go into any shop and read any working drawing; also, that they receive a few lessons in perspective."

No. 8 is from a graduate, working as a mechanic.

"I have a better position now than young men that have been in the same shops for three years, and I receive more pay."

No. 9 is from a graduate twenty years old, who is a stenographer in the office of a railway company.

"I consider my training at the Manual Training School as being indispensable to myself, and do not see how a young man of a mechanical, mercantile, literary, or even any professional turn of mind, can consider his education completed, or be satisfied with it, without having had at least a taste of manual training. . . . In every-day life, it makes no difference what the profession or occupation of one may be, something will turn up, where the training, such as I received at the Manual Training School, will become essential to the success, advancement, and improvement of a young man."

No. 10 is from a young man in the junior class in dynamic engineering. Of his vacation work he says:—

"During last summer I received $2.50 per day when I was drawing, and $2.00 when I worked at the Exposition. At the latter place I was learning to put up pipe-work."

One of the most valuable results of manual training he thinks is:—

"The habit of systematic work; I mean the habit of laying a definite plan before starting upon a piece of work or action."

The mother of No. 10 and of a graduate in the last class writes, speaking of a third son who did not take the Manual Training School course: "I now think that it would have been to his advantage to have taken the course in the Manual."

No. 11 shows that though we have no leather work in the school our training is not lost on a shoemaker of the modern sort.

"I am running a petroleum engine and a heel-trimming machine at a shoe factory. . . . I receive $18.00 per week. . . . I consider the training I received at the Manual Training School almost indispensable; in fact, it is what gave me my present situation."

No. 12 is a young man who learned all that was to be learned in the printer's trade and then went into the counting-room of a daily newspaper. His father, the editor and proprietor, thus writes:—

"I assure you with great pleasure, that I would send as many boys to your school as I could possibly control in that respect. Judging from experience I feel satisfied the training there benefits them not only in point of general intelligence, but as to prompt-

ness, skill, and all other particular points alluded to in your circular, equally as well."

No. 13 is from another junior student in civil engineering. He thus speaks of his vacation work and of his preparation for the university :—

"At present, rather than be idle, I am engaged running an engine on a derrick boat at 15 cents per hour. I tend to both the boiler and the engine, and have sole charge with the exception of a foreman who looks in about once a day. During the past vacation and holidays, when there was any work, I was employed by an architect to line and fill in plans and elevations, receiving $2.50 per day. . . . As a preparatory school for the university, the course has one disadvantage in my opinion, and that is, it is too thorough and comprehensive for the Freshman year, thereby lessening the pleasure and enjoyment of its studies, while it is not advanced enough for the Sophomore class."

His employer thus writes of him :—

"A young and energetic boy has worked in my office during vacation and holidays, and his knowledge and quick perception in mechanism and drawing are wonderful. Practical knowledge is the road to success."

No. 14 says :—

"I am employed as rodman on the White River Branch Extension of the Missouri Pacific Railroad. My wages are $45.00 per month, and I do not know as my Manual Training School education places me on any better footing than other young men, except as it may have taught me to swing an axe. This is a heavily wooded country, and on construction there are a good many stakes to make and drive. I think very highly of my Manual Training School training. It has given me an insight into many things I never would have thought of or investigated. The only disadvantage I have found is, that when you tell people that you are a graduate, they imagine you are a competent mechanic, and are disappointed when you inform them of the facts.

"I would advise any young man to go to the school, who was going to study any branch of engineering, or who wanted to be a mechanic. I think it would be a fine thing for him, if he expected to rise in his trade."

No. 15 is a successful teacher of manual training on a salary of $1,050. He thus writes:

"I think my training at your school is the best I could have received, as the combination of work is such that I have received an insight into the most prominent trades; and it has placed me in a position to judge intelligently what trade I would like to follow for a livelihood. It has made me self-reliant, and I feel that I could easily learn any trade, if I should go at it in the systematic order that we followed in our school-work."

He then proceeds to criticise our drawing, and adds:—

"My plan for drawing would be to have it more closely connected with the shop-work, and to have each scholar learn the fundamental rules of drawing, and not to have the teacher do so much work for the students."

My readers may be sure that I attach great weight to this suggestion, though there is little occasion for such criticism now. Of this young man the city school superintendent writes as follows:—

"I do not hesitate to pronounce Mr. B. manly, intelligent, prompt, precise, skilful in his work, competent to direct it, winning the confidence of his employers, and the respect of his pupils. He has far surpassed our expectations. . . . I have believed that the manly qualities which he seems to possess in an eminent degree have been greatly strengthened by the course of training he received in your school."

No. 16 is a boy who is employed in a brass shop and foundry. His experience is a capital illustration of the general value of our training.

The principal part of my work is the making of wood and brass patterns and core-boxes, and keeping them in order. I also do the greater part of the drawing for the shop ; but I am by no means limited to these, as, for the last three or four days of each month, I am called to help get work out, and to help Mr. Jones figure, &c. I have also done a little tool-work, such as turning, milling, hardening, and tempering cock-reamers, and taps. I also have made a few cutters for a monitor lathe. *I usually get the work that is out of the ordinary line.* . . . Since writing the above I have asked my employer his opinion [of the school training]. His answer is almost the same as mine, with the addition that the instruction received so broadens the mind, that a student's selection of an occupation is apt to be more intelligent. He says if he wanted an assistant, draughtsman, or an apprentice, he would most emphatically select one from the Training School."

No. 17, who is engaged in building, heating, &c., says :—

"My prospects, present and future, are favourable, with a good bank account and *no debts.* I never enjoyed a school more, or felt more improved by one. I think the 'Training School' helped me in many ways. Before I went there I took no interest in improvements, such as buildings, machinery, locks, drawings, &c. ; but now everything of that kind interests me."

No. 18 is manly and kind. I see in what he says a criticism of the right sort, and I am willing that my readers should see it too.

"As to my general training at the school I can say nothing less, so far as I am now able to see, than that it is proving to be of inestimable value, not only in familiar subjects, but in subjects radically new. Its advantages are in being perfectly general, and fitting for almost any occupation. I have thus far been unable to see any disadvantages. What I consider of great importance is the matter of every-day English composition ; and though I do not deem our graduates deficient in this

respect, yet I think that additional work might be done in that direction, to great advantage. Letters from my classmates urge me to make this remark."

No. 19 is from a student taking a literary course in a university, preliminary to the study of law. He says:—

"When I entered I was rather weak, and my head was in advance of my body. The work at the school developed my body, and gave to my mind a clearer and more practical view of things. If a person intends taking an engineering course, I should advise him to go through the Manual Training School by all means. To a person intending to go into business, I think the training secured by the combination of mental and manual labour is almost invaluable. I have a brother who intends to go into business, and I expect him to apply for admission to the school this fall."

No. 20 is still a student of engineering.

"In reply to your circular of the twenty-fifth, I wish to say, that the instructions which I received at the Manual Training School have been of great benefit to me, inasmuch as I am able to judge of the quality of work which I see, as well as to do some work myself. I have never worked steadily for any one man, for the reason that there has always been work enough about the house and in the neighbourhood to keep me busy during vacation.

"My work all along has been of the nature of odd jobs at carpentering. In this way I have been able to earn, on an average, $2.00 a day for every day that I worked.

"The instructions in drawing combined with the work in the machine-shop enabled me, by the time I had finished the course, to understand the general construction of such machinery as I saw, and at the same time to form some idea of the way in which those parts which are hidden from view might be constructed. To one who desires to learn a profession in which construction is an important feature, such a course would be very beneficial; for by knowing the different methods by which

an article can be made, it seems to me that he will be enabled to so do his designing as to avoid all unnecessary complications, and consequently have his designs worked easily and cheaply."

No. 21 made the dynamo that lights his house.

"My training at the Manual has given me a foundation from which to work. I have now a very nice shop in good running order; I have a four-horse power engine (which I built myself), and two lathes and a grindstone, running almost every day, while myself and brothers work in the shop. I think that every boy, no matter what calling he intends to pursue, should have some such training as we got at the Manual."

This young man adds, that unfortunately

"The average boy when he graduates from the Manual has far too good an opinion of his abilities. The public also very often over-estimates the amount of training which one gets there. They think that he is a finished mechanic."

I have no doubt such is the case. As to the conceit, I am not sure that our graduates are much better off than graduates of other schools. We try to cultivate modesty, and to show the boys the vast amount of their ignorance.

As to the estimate strangers place upon our work, that will right itself in time.

No. 22 is a student of architecture at Cornell University. He says:—

"After leaving the Training School I went to work at the bricklaying trade. I had worked at it during vacation, while attending the Training School. It took me altogether about two years to learn my trade, the regular apprenticeship being four years. I attribute the aptness with which I learned my trade to the excellent training received at the Manual Training

School. During my last year at the trade I received full wages, $4.50 per day.

"I think the course of study at the Manual Training School a splendid thing; and I would advise every young man, no matter what his occupation in after-life may be, to avail himself of the opportunity of such an education, if it is in his power. It enables one to better understand the doings and workings of our scientific world, and at the same time, it brings with it an appreciation of good workmanship and skill in the use of tools."

No. 23 was a farmer's boy; now he is teaching shop-work and drawing.

"I think that I have an insight into the care, use, and abuse of tools and machinery, so that I could or would be more likely to get a position in a shop, or begin business for myself. Most of my knowledge of tools I got there at school, for I had touched not even a jack-plane before I went there. A good point is, that it gives a broader education, and makes a true feeling for honest labour and good workmanship wherever you see it."

His father adds:—

"A farmer's boy, after going through that school, can mend and make many things that would have to be taken to a machine-shop, or can see what is the matter with a machine that is out of order. Nowadays a farmer must have a good understanding of tools and machinery, we have to use so much of them. If I was going to hire a man, I would sooner have a graduate of the Manual Training School."

No. 24 is evidently well pleased with his prospects.

"My position and pay rank far above those of other young men in similar business."

No. 25. This young man is an Illinois farmer.

"I am married, and have a little boy; and if he lives, and

I can afford it, he shall go through the entire course of the Manual Training School. By this you may infer what my ideas are as to the advantage of manual training over commercial or common high schools. I have been putting my money into stock and farming implements, although I have good reason to believe that I make as much or more money than my neighbours, some of whom are old and experienced farmers; not that I raise better crops or work harder; but that I have saved and am saving a good many dollars which they give to carpenters, blacksmiths, or waggon-makers, for repair-work, *which I do myself*, with the skill I obtained while at school. As soon as I move, I expect to fix me a blacksmith and carpenter shop, and increase my present incomplete set of tools, with which I expect to do all of my own and part of my neighbours' repair-work, which will be a great saving in money and time."

No. 26 is with a gas company. He began at the bottom.

"My wages are \$66.66⅔ per month, \$800.00 per year. I consider my training at the school of the greatest benefit to me, as I think that my knowledge of tools, besides my learning in the three R's, was what helped me to get my place as inspector. I used what knowledge I had of tools to the advantage of the company, especially that of blacksmithing, but my machine-work and carpentry come in handy now and then. If I had not given satisfaction down-stairs, I would never have been upstairs."

No. 27 is making himself valuable to the lawyers.

"In December, 1885, I commenced in the drawing-room at \$5.00 a week. I worked hard to make myself valuable, and in two months and a half I received \$6.20, and very soon after that \$7.25 per week. In May, 1886, I was offered a situation with my present employers as draughtsman at \$50.00 a month, and after due consideration I accepted the same. When I informed my former employers of my intentions, they wanted to know if I would remain with them at \$50.00 a month; but I had accepted this place, so I had to refuse. My work with this

firm is making all the plats for certificates, examinations, and abstracts of land-titles, as well as entering in our plat-books all the subdivisions and additions recorded in the court-house.

"I cannot well compare myself or my salary with any one in the office, since I am by many years the youngest in the office, and most of our clerks are lawyers. Should I ever be fortunate enough to have a son, and be able to send him there, he shall certainly go to the Manual Training School."

I could quote much more fully and from many more, but these must suffice. The attendance in our school of younger brothers and friends of graduates is the best commentary on our work. About half the boys who attend the school get less than the whole course. For a great variety of reasons they drop out.[1]

A much larger per cent. of such boys become mechanics than of the graduates. I have had many excellent reports from and concerning them. But I have not kept the reports on file.

Since writing the above, I have received a letter, which is good enough to cause me to open the case once more. I give all but the formal beginning and end of the letter. The writer was a graduate in the year 1883. His record was that of a good, careful student, not brilliant, but on the contrary so slow as to cause him at times to appear dull. He entered this pipe-factory soon after leaving school; one of the first things I heard about him was, that he had invented and made a new tool, by which he had been

[1] The school is not free, and the number of free scholarships is limited. To many parents the expense becomes a heavy burden.

able to outstrip the old hands who had been turning for years.

No. 28. He now says:

"My work is that of turning all kinds of fancy and common parts of the corn-cob pipe, and I am classed upon my employer's books as 'head turner.' My present or recent wages per month are from $60.00 to $90.00, depending on the kind of work given me; while other turners draw from $40.00 to $65.00 per month. I hold the best position in the house, next to the foreman, and average about $10.00 or $20.00 a month more than men of my own age in the establishment.

"My training at the Manual Training School has been of great benefit to me many times, and in many places. I have made drawings for machines, designs for pipes, patterns, tools, and machines of different kinds. Other positions have been offered me, but as I have a mother and three sisters to care for, I preferred to stay in Washington [Mo.].

"Mr. K——, one of the managers, told me the other day, they expected to make me foreman after Jan. 1, 1887; a very good position, paying from $125.00 to $150.00 per month.

"I would advise any young man to attend the Manual Training School, if he wishes to be constantly employed and make good wages. If he wants to be an engineer, let him attend that school before entering the polytechnic.

"Enclosed please find Messrs. H. T. and Co.'s answer to question six."

The letter from the firm, addressed to him, is entire as follows:

"DEAR SIR,—With pleasure we answer question six of circular submitted to us by you.

"Your position you owe to your training at the Manual Training School. Our oft-repeated consultation regarding new shapes or styles of goods would show that your 'ability to understand what is new' was duly appreciated by this firm.

"Yes, if all the graduates of the Manual Training School showed such intelligence, promptness, and precision as we

found in you, we would certainly give such graduates a preference.

"Respectfully yours,

"[Signed] "H. T. AND Co."

Will some one complain that these young men have no high ideals? that they do not quote classic examples of patriotism and devotion to lofty aims and high arts? Will it be asserted that their ideas of life are unpoetic, materialistic, limited to good wages and methods of "getting on" in the world? If so, I shall say in reply, I am willing to trust the future for evidence of right and noble living. My confidence would be less if they talked more about it.

CHAPTER XII.

THE INTELLECTUAL VALUE OF MANUAL TRAINING.

DR. D. A. SARGENT, of Harvard University, has told us how he planned the Hemenway Gymnasium, and how he marks out the course of physical training for individual students.

He says:

"In looking over the records of the students I had examined, I found that the young men who had been accustomed to walk long distances to and from school, and to spend certain portions of the year doing manual labour on the farms, in mills, lumber yards, &c., generally showed a superior physique, unless the work had been excessive and begun at too early a period. Moreover, I found that the young men who had been accustomed to special employment, such as blacksmithing, wood-chopping, milking cows, &c., showed a special development in certain parts of the body, as the forearm, upper-arm, and back, while they were lacking in the development of other parts.

"In this way I went through the list, marking the peculiar development that seemed to accompany the special occupations and exercises to which the boys had given attention before coming to college.

"The conclusion that I reached was this: if actual labour will produce such good physical results in certain directions, why will not a system of exercises in the gymnasium, resembling actual labour, accomplish the same results? In this way it may be possible to supplement the deficiencies of one's occupation, and to develop him where he is weak."

Accordingly he set to work to invent pieces of

apparatus which should serve to develop particular muscles or sets of muscles. The variety of apparatus in his gymnasium is very great, and the visitor is sure to be interested in the nature and special functions of each piece. Having thus made preparation for complete and analytical physical culture, he must diagnose his patient:

"As soon as the student presents himself at the director's office (which is done by application and appointment), he is given a history blank, which he fills out, giving his birthplace, nativity of parents, occupation of father, resemblance to parents, natural heritage, general state of health, and a list of the diseases he has had—all of which information is absolutely necessary in order for the examiner to put a correct interpretation upon the observations to follow.

"The student is then asked to make certain tests of the muscular strength of the different parts of his body, and to try the capacity of his lungs.

"He then passes into the measuring-room, and has his weight, height, chest-girth, and fifty other items taken. His heart and lungs are then examined before and after exercise, and a careful record made of the condition of his skin, muscles, spine, &c., which the tape-measure fails to give.

"All the items taken are then plotted on a chart, made from several thousand measurements, and the examiner is then able to know the relative standing of this individual as compared with others for every dimension taken, also his deviation from symmetry, and the parts which are in special need of development.

"From the data thus procured a special order of appropriate exercises is made out for this student, with specifications as to the movements and apparatus he may best use."

There is much that is suggestive in this account of Dr. Sargent's. The intellect as well as the body has its

wide range of special functions and activities. The intellectual powers are developed by exercise, but not all equally by every exercise. Psychology and pedogogical skill should do for the mind what physiology and Dr. Sargent have done for the body. There are those who think that physiology and psychology meet in the brain, and that one's mental condition of strength or of weakness would stand revealed if his brain and nerves could be properly examined. But a direct examination of the contents of the skull is impossible during life, hence we need not digress into physiological psychology.

Is it impossible, then, to diagnose one's mental condition? Dr. Sargent "sizes up" his student by means of tape-line, heart-beats, and test exercises. The mental examination is immeasurably more difficult, but we inevitably make one, more or less complete, with every new student who comes under our care. Mentally we diagram him, decide where he is strong, where he is weak, and then proceed—strange perversion of our high office!—to strengthen him where he is already strong, and to neglect him where he is weak.

But how is our gymnasium equipped? What special means do we employ to develop the perceptive powers, memory, imagination, judgment, comparison, generalization, and so on, with minute division and subdivision? Do we adopt Dr. Sargent's method? He could not bring into his gymnasium trees to be chopped, cows to be milked, horses to be shod, mountains to be climbed, grass to be mown, or boats

to be rowed; so he devised apparatus all under one roof which should have approximately the same physical effect. In a word, he substitutes *physical training* for *physical labour.*

I fear we have trained the intellect less thoroughly and less wisely than Dr. Sargent has the body. We have been too unwilling to learn from the world around us. We have been too much under the influence of tradition and conventionality. We have slighted certain powers and trained others too exclusively. As Dr. Hudson has said, we proceed upon the notion that our children's "main business in this world is to shine and not to work." The memory has been exercised to the neglect of the perceptive powers. Instead of exercising the judgment upon primary concepts, we have flooded the mind with secondary knowledge, and forced upon it the judgments of others. Hence instead of being self-poised our students are propped by authorities; instead of personal experience we substitute the printed page which contains in words but imperfectly understood the recorded experience of others. If Dr. Sargent, having prepared his splendid gymnasium, and diagnosed his freshman, should say to him: "These are the special pieces of apparatus carefully designed for just such cases as yours. Here are full printed descriptions and drawings from which you may learn the theory of the device in each case; and here are printed reports from those who have tried the apparatus, showing just what the physical effect has been. Study these pamphlets with care, and be ready for a

written examination in three weeks." If you get a high mark on your written work, you will be excused from using the apparatus. If Dr. Sargent should say and do thus, he would closely resemble many educators who persuade their pupils that they may become wise and strong without experience by reading about a strength and wisdom that comes only by experience. In my first chapter I pointed out the general defect of our school training; relying too exclusively upon books and the method of memory, it lacks the vigour and emphasis of good training. I say the traditional method is lacking; it does not contain the proper elements in the right proportion. In saying this I do not declare it worthless, nor do I advise that any of its features be discarded. I only demand that the programme be so modified as to admit of exercises which serve more efficiently than any yet devised to supply the deficiencies of the old system. The needed exercises are found in manual training.

It would be folly to suppose that nothing but manual training can furnish the needed elements of discipline. To a greater or less degree they are found in labour, on the farm, in the garden, in the factory, and on board ship; in roughing it in camp; in hunting and fishing; in field sports; and in practical science study. But the difficulty comes here as it did with Dr. Sargent: we cannot bring the farm, the factory, the camp, and the field sports into the school-room; and as for practical science, which is already a part of our curriculum, or should be, it suffers

greatly from the lack of elements which can be more efficiently furnished elsewhere, and which it is not its proper mission to supply. To meet this difficulty a carefully graded course of instruction in tool-work, with a wide range of material, accompanied by a thorough and elaborate course of draughting, has been arranged and thoroughly tested. So far as is known, manual training supplies the missing links very satisfactorily without interfering injuriously with book study. On the contrary, it appears to have a very beneficial effect on literary and mathematical work, while it is a powerful aid to science study.

Just what manual training is and how its benefits are conferred, has already been in part set forth. As has been intimated, the analysis of mental activities while the boy reads a book, executes a laboratory exercise, plays a game of tennis, or repairs a kitchen clock, is not a simple matter. Many things are felt which words cannot express. The basis of such analysis must be personal experience, and the comprehension of the analysis by another rests upon a similar basis, which furnishes through words an intelligible means of expression and transmission of thought. Human experience is so various and so defective that we are repeatedly left to inference and conjecture.

The mental activities involved in a shop exercise are best learned by experience; next they are inferred from an intimate knowledge of the state of mind of the doer of the exercise, and of what is presented to and demanded of him. Hence the activities depend

both on the student, the teacher, and the accidents of the particular exercise. Every analysis of such activities is therefore a particular and special one, just as it is in a lesson in geography, or arithmetic, or botany. But certain faculties of the mind are engaged in all mental work, though in varying degrees. Shop-work furnishes unusual facilities for cultivating the perceptive powers; the boy uses his tools as the student in science does his apparatus, chiefly as the necessary means in forming correct ideas. Only personal experience gives clear concepts Given clear concepts, the mind is in the most favourable condition for healthy action: the memory is retentive, the imagination lively, the judgment sound.

But let us take up these matters more in detail. We are all conscious of being much influenced in our thinking by the opposition or criticisms of others. It will best suit my present purpose to follow the lead of an eminent American educator,[1] who recently published what was intended to be an exhaustive analysis of the intellectual elements involved in manual training.

To be sure, Dr. Brooks claims to be in favour of manual training, and he takes the very sensible ground—not always taken by educational people—that "the object of the public school is to prepare pupils for life; that the possession of manual skill is preparation"; and that, therefore, the public school should make some provision for such training. The

[1] Dr. Edward Brooks, of Philadelphia, late Principal of Penn. State Normal School.

practical value of a knowledge of tools is so great that he regards "manual training as almost indispensable in the education of boys and girls."

But he thinks we claim too much for the mental discipline afforded by manual training. In support of this position he gives an "analysis of its influence upon the different faculties of the mind—perception, memory, imagination, generalization, judgment, reasoning, &c."

His argument runs thus:

PERCEPTION.

"So far as discipline of the perceptive powers is concerned we can give just as much training without doing the work, as by doing it, and much more in the same time. A boy who has never made a piece of dove-tailing can have as clear an idea of it as one who has done the work."

And again:

"A few minutes of careful examination of a piece of dove-tailing would give as clear an idea of the process as several days' labour in doing a piece of dove-tailing."

Parallel statements will best show how far from the truth these assertions are:

A boy who has never played a certain piece of music can have as clear an idea of it as one who has played it through!

A few minutes of careful examination of a map of a country would give as clear an idea of it as several days' labour in drawing its outlines and locating its rivers, mountains, towns, &c.!

And, *a few minutes of careful examination of a piece of physical or chemical apparatus would give as clear an idea of the process of using it as several hours' labour in performing experiments with it!*

Are not my statements as fair and reasonable as his? And yet how false and even absurd they all are! Please observe that he speaks of a "clear idea of a *process*," which he thinks can be got from "a careful examination of a *piece*." The details of a process may be the object of study and observation as well as the details of form, and the intellectual operations involved are far more important, as may be easily shown. In fact, there is an intermediate exercise between examining a piece of work and making it, which is also of intermediate value intellectually. I refer to the exercise of preparing an accurate drawing of the piece. There are then three exercises in the form of a logical series: (1) Examining the piece; (2) drawing the piece; and (3) making
P the piece: and the degrees of intellectual activity
anal olved form a corresponding series. Let us consider
manua in order.

To be s examining a piece of finished work one
manual trai the facts of its form, colour, and possibly
ground—not a And these facts are seen qualitatively,
that "the object quantitatively; that is, he notes the
pupils for life; that es, angles, and surfaces only ap-
preparation"; and th general way.
should make some provis makes a scale-drawing and

[1] Dr. Edward Brooks, of Philadelphia detail of the piece is to
Normal School. to be applied, and the

proper length is to be put down on the drawing; then to make assurance doubly sure, actual lengths and angles are indicated in figures. The impressions thus made upon the mind are much deeper and more lasting than could result from an examination without drawing. Moreover, the draughtsman draws several "views" and, perhaps, sections, each involving the process of abstraction and mental picturing in which the quantitative relations are necessarily prominent.

3. Now, finally, consider the making of the piece. Forms and dimensions are still of vital importance, but they are by no means all. Here come in elements that neither the examination nor the drawing possessed. Not only the properties of the materials, the nature of the tools, and the methods of their use, but the sequence of steps and the reasons for that sequence are brought vividly before the mind. This is an exercise in logic, either in the recognition of reasons for previous judgments, or in forming judgments for one's self. It is therefore difficult to compare the intellectual activity involved in making a piece from one's own drawing, with that involved in a mere examination of the finished piece, so immeasurably greater is the former. [See Note at the end of this chapter.] But it may be answered that nothing was sought but a general idea of the finished piece; that the details of the process of its construction are of no great value to the majority of students. I think that no one can thus answer after reflection. To me a thorough knowledge of a process that is to

produce a result is of vastly greater worth than anything that a superficial examination of the product can yield. To know *how* and *why* and *by what forces* things become what they are, is to begin to solve the universe, and every act of logical quantitative construction is training to that end. If Dr. Brooks supposes that our students make dove-tailed joints for the simple purpose of learning what dove-tailed joints are, he is very wide of the mark.

MEMORY.

"In respect to the memory, manual training gives little or no discipline to it as compared with the other studies of the public school."

Thus briefly does the Doctor consider memory.

Now, I do not claim that in manual training there is much practice in memorizing things which are feebly associated, such as: the names of persons and places; rules one but partly comprehends; the forms and definitions of words which are unfamiliar and apparently arbitrary, &c. The manual teacher rarely asks his pupils to commit to memory the details of a process, the reasons for his choice of tools, the order he adopts in the execution of an exercise, and the new words he uses. The pupils remember them as matters of course, and when required to write them out days afterwards they often do so with surprising accuracy. [See Note at the end of the chapter for an example of unconscious memorizing.] But perhaps Dr. Brooks does not think the memory exercised by such matters, nor unless the mind is employed in

efforts to retain words, statements, and ideas from the printed page. A student once told me that it was impossible for him to remember the forms of irregular French verbs. He read them over, and immediately forgot them. I asked him if he ever forgot how to set up a battery. "No," said he promptly; "I never forget what I do with my hands." There is plenty of practice at remembering things in manual training, but the pupils remember them without trying, so vivid are the impressions on their minds. The matters remembered usually stand in the relation of causes and effects, and the recognition of such relationships is in itself valuable mental exercise.

IMAGINATION.

Dr. Brooks's entire argument under this head is:

> "The use of tools affords but little discipline to the imagination compared with literature, history, &c."

Doubtless the cultivation of imagination in a laboratory differs from that gained in literature, but it is not the less valuable. The truth is, tool-work and shop-drawing train the imagination most efficiently and in a most useful direction. The clear mental images which graduates of the Manual Training School are able to form of purely ideal things often create surprise, but they fully explain the admitted fact that manual graduates, whether in higher education or in places where the great world works, grasp the conditions of new and useful pro-

blems much more quickly than do those whose training has omitted the manual elements. Manual training begins most successfully that cultivation of the scientific imagination which Tyndall says is the essential condition of the best work in scientific research.

GENERALIZATION.

All that Dr. Brooks says under this head is, that manual training "gives no culture whatever to the power of generalization."

This statement must greatly astonish every teacher of a manual training school. From the first touch of tool to stock, the boys—like the blind men who went to see the elephant—begin to generalize; and though, still like the blind men, they generalize correctly from their standpoint, a new standpoint compels a new and wider generalization, and so on without cessation or limit. The value of their generalizations is in proportion to their experience, and hence arises one explanation of the practical advantage the manual graduate has over those who lack his experience in dealing with real, concrete things. The properties of materials; the relations of friction to pressure and to heat; the influence of heat upon iron, upon steel, upon wood, upon watery solutions; the relation between cutting edges and the properties of the material to be cut; the effect of lubricants; the relations of shapes to strength; the class of cases when this tool, this process, this material, this colour (in tempering steel), this tint (in draughting), this pro-

jection (in drawing), is to be preferred to that; the ways in which persons of certain mental habits and mental furniture will be affected by certain difficulties; the conclusions which persons in certain positions and in the face of certain influences are almost sure to draw; just "where and why the shoe pinches," &c., &c.; such are some of the more obvious opportunities for generalization which are actually forced upon every student in a well-conducted series of shops.[1]

JUDGMENT, REASONING, &C.

Dr. Brooks's analysis of the effect of manual training closes as follows:

"The use of tools requires some exercise of judgment but very little of the power of reasoning, expecially as compared with arithmetic, grammar, algebra, geometry, natural philosophy, &c. For the culture of thought-power, therefore, including abstraction, generalization, judgment, and reasoning—the most important part of intellectual training—the influence of manual training is so insignificant as to be hardly worth mentioning."

Dr. Brooks lives in Philadelphia, where, as I have every reason to believe, there is a manual training high school under excellent management. Has he ever made a careful study of that school? Does he

[1] "The mortise and tenon are not simply two bits of wood fitted to each other, but an embodiment of a thought covering a host of necessities in building. The process of generalization must have reached out towards these many applications, or the work does but little in the way of education. With this the work gives precision to thought" (Address of President Fairchild, of Kansas, in San Francisco, 1888).

know from personal observation anything of the mental activities of the students while receiving instruction or engaged in practice in the laboratories of that school? Has he had charge of shop-trained[1] students in his favourite branches of mathematics? I think he must answer, No; otherwise he could never have written the above.

One's power of thought depends largely upon the way in which he interprets what he sees, and upon the fulness and clearness of his mental concepts, especially upon his recognition of the relations of cause and effect. A course of reasoning is like a train of wheel-work where each "driver" and "follower" serves both to transmit and to modify motion and force; or like a series of manual exercises which form a logical sequence, like drawing, pattern-making, moulding, casting, and finishing. Such a series, more or less extended, every manual boy must go through before his course is complete; and he never loses sight of the necessity of adapting means to ends. My observation is that such train-

[1] By "shop-trained" I mean actually *trained* in the theory and use of tools. I do not mean that system of no-training popularly called "apprenticeship" where the boy is uniformly knocked about from one form of drudgery to another, and as uniformly not taught; where, to quote the London *Journal of Education*, "if a young man asks an old one why this or why that is done, he gets the answer: 'Tha want ta know ta mich. Tha do exactly what a tell tha, and tha'll do reet.'" Such methods make boys stupid by repressing their natural appetites for correct reasoning. This resort to authority, without reason, reminds me of the days when I was learning to scan Latin poetry. If we could not find the rule which made (*sic*) the quantity of a syllable what the metre required, we always fell back upon the convenient explanation: "It was so by authority."

ing is highly conducive to vigorous, manly, logical thinking.[1] What I have already said under Perception and Memory show plainly that the shop of a manual training school encourages and stimulates thought. It is true that though the shop atmosphere conduces to active and correct thinking, it is not the business of the shop to call attention to the mind's activity: that belongs to another department of education. Manual training is only one part of education, and on the whole a small part.

I do not find it necessary to contrast the mental effect of tool-work with that of mathematics or literature. All are necessary in a rounded education, and in spite of Dr. Brooks's rather ambiguous assertion that "more mental discipline can be given in the same time without manual training than by any system of training in the use of tools that has ever been devised," I unhesitatingly declare, without fear of successful contradiction, that in the case of a boy in his teens, taking him day by day during his school term, more mental discipline can be given by combining manual training with the study of mathematics, science, and literature than by omitting manual training and giving the attention exclusively to the other subjects.

Intellectual growth is not to be gauged by the

[1] Superintendent J. E. Bradley, of Minneapolis, speaking from two years' experience with manual training in the city high school, writes: "Manual training is more a means than an end. It gives vigour and directness to every mental operation. The lessons learned by use of tools, such as accuracy, adaptation, and persistence, are the best possible preparation for other relations and other pursuits."

number of study-hours, nor by the length of recitation. So long as one gives undivided attention to his work his mind grows. When attention flags or is divided, healthy growth stops. The statement is equally true for the lad who pores over books and the one who handles tools. If either is kept at his task after his lively interest has ceased, he forms the stupefying habit of thoughtless, unintelligent action which approaches automatism, and which is fatal to intellectual progress. It is for this reason that over-schooled pupils and drudging apprentices get on slowly mentally. Their chief interests and their chief enjoyments are outside their line of study and their daily toil. The sharp distinction modern society makes between the boy who works with his hands and the boy who works at his books has driven both to extreme positions which are unfavourable to the healthy development of either. There is no question but that the untaught, unreasoning, unscientific labourer is extremely stupid; neither is there any doubt that bookish people whose personal experiences are at a minimum, whose ideas and opinions and convictions (?) and information are derived from books and the statements of others, are extremely stupid and helpless when face to face with the world for which their education is supposed to fit them.

I have thus taken up Dr. Brooks's mental analysis point by point, and found his assertions unfounded and his arguments weak at every step.. And yet I feel that I have not put my best foot forward. The healthy mental activity which invariably accompanies

properly selected and skilfully conducted tool-exercises is more easily recognized than explained. The living reality of the students' work; their natural craving for physical activity and personal discovery; their recognition of economic bearings; and, above all, the thought-provoking character of the principles of mechanics, all stimulate the mind. It has been well said by one who makes the comparison suggested by Dr. Brooks: "The intellectual culture of active art is far more vigorous than that of literature. In literary culture we feebly and indefinitely grasp ideas by their association with printed words. There is no life, no force in the object of our study. In industrial art we are continually stimulated by the presence of the object, and the operations we are performing, and our perceptions are clear, positive, and exact. The concentrated attention, the close observation, the ingenuity, invention, and judgment in use in art are far superior as mental discipline to any that literature can give." The word "art" is here used in the widest sense.

ARE SKILFUL TEACHERS NECESSARY?

But the crowning fallacy of Dr. Brooks's essay and one which I think he will on second thought discard, is found in the following sentence:

> "For real valuable discipline, I believe that a boy in his father's shop, working without a teacher, will gain more mental development than when under the more skilful guidance of a teacher, though of course what he produces will not be so perfect."

To show the utter absurdity of this belief, I will make further use of the argument, *reductio ad absurdum*, and introduce some perfectly fair parallel statements which I wish the reader to weigh carefully:

For real valuable discipline, I believe that a boy in his father's mathematical library, working without a teacher, will gain more mental development than when under the more skilful guidance of a teacher, though of course his mathematical style will not be so elegant!

For valuable discipline, I believe that a boy in his father's classical library, working without a teacher, will gain more mental development than when under the more skilful guidance of a teacher, though of course his translations will not be so perfect!

In one rash sentence Dr. Brooks undermines all school education. If what he believes is true, then my parallel statements are true, and so are others like them; and we are forced to the conclusion that in all studies where the "product" is of no account, and where the sole end and aim is "valuable discipline" and "mental development," no teachers are needed. All that is necessary is to turn a boy loose into libraries, museums, cabinets, gardens, laboratories, music-rooms, and tool-shops, and he will fare better intellectually than under "the skilful guidance of teachers." To such dire conclusions must logic lead him!

But I am sure that Dr. Brooks holds no such views. How then can we explain his position? What is the missing premise which he used in the case of the shop but would not use in the case of the library? Dr.

Brooks is fond of formal syllogisms, and possibly he reasoned thus :

1. When the appliances employed in education explain themselves sufficiently for the most valuable discipline and the best mental development, the skilful guidance of a teacher is not necessary.

2. In the case of a tool-room, the ideas involved in the construction of the tools and the methods of their use occur sufficiently for the best mental development to the mind of a boy when left to himself.

3. *Therefore*, in a tool-room a boy does not need the skilful guidance of a teacher.

I submit the above syllogism as an analysis of the Doctor's unconscious reasoning. He could have reached his conclusion in no other way. If I am correct—and I think I am—I object most strongly to his minor premise. The ideas involved in the construction of tools—and tools are crowded with ideas, —are by no means obvious to the average boy.

Under the guidance of a skilful teacher a student recognizes qualities in right methods which he never would discover for himself; and this is as true in a tool-laboratory as in a chemical laboratory or in the class and lecture-room. Nothing so stimulates intellectual life as intellectual life, and a skilfully guided class in tool-work is full of intellectual life. As I said, the tools are full of ideas,[1] and those ideas are

[1] "The long tradition of innumerable ages and the vast accumulation of technical wisdom that are manifested in the various handicrafts have always been interesting to me" (Hogg's "Life of Shelley").

"A spade is a very simple garden implement, but its history would be the history of civilization" (Gov. Stanford of California).

directly related to the materials to be wrought and to the correct use of tools. Without that correct use the ideas involved will not be recognized. When, however, under skilful guidance the boy with his own hands realizes correct methods of using tools, he unlocks the secrets of their construction, and the thought of the maker or contriver stands revealed with a vividness which makes the impression lasting and the enjoyment keen.

A skilful teacher transforms a shop. It is no longer a place where tiresome work is done, where one's fingers are soiled, and one's palms are made hard. It is a mine of valuable ores and precious stones which may escape the untaught, but which richly reward the efforts of the skilfully trained. I asked a student recently—and a very excellent student he was in geometry, Latin, and sciences as well as in drawing and shop—which of all his exercises he enjoyed the most. At the moment, I was thinking particularly of his Latin, which I knew he liked exceedingly. He began his answer half apologetically: "Well, of course, one can't help liking shop——" Now why? That enjoyment comes from no shallow curiosity or fancy which would not have survived a single week. This boy was in his third year in the school, and his shop work was at the time in the machine shop, where powdered metal and oil combine to soil one's hands and garments, and where all the work for the term was upon abstract school exercises devised by the teacher to embody as much experience and as many principles as possible. It was clear that

his interest and enjoyment sprang from the fresh ideas he was all the time meeting, and from daily discoveries, under his teacher's skilful guidance, of new functions and new powers in tools, which he would never have found out by himself.

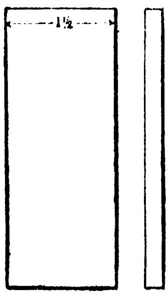
No, the Doctor's premise is wide of the truth, and hence his conclusion is wrong. He must still believe with me, that education in all its fields is a science; that there is still need of the guidance of skilful teachers; and that it is to such institutions as that which he has conducted so efficiently that we must continue to look for that training which is to produce the skill requisite to a successful teacher.

NOTE.

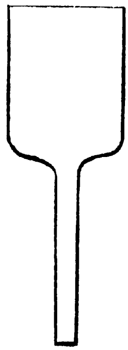
THE DETAILS OF A PROCESS.

The vast difference between the mental phenomena aroused by the examination of a finished piece and those which accompany its actual construction is well illustrated by the following exercise in steel forging. It is an exceedingly difficult exercise and should not be given to boys of sixteen till they have had considerable practice in managing the forge, and in drawing and bending steel. It is first executed in lead where the steps are nearly the same as in steel, and with which the greatest deliberation may be exercised while the details of form, force, and motion are studied. It is also proper for me to add that the instructor not only makes and explains this series of drawings to his class, but he executes the fork in

both lead and steel. With the latter material the greatest care is to be taken that it is not burnt by too high a heat, nor broken and split by being wrought when too cool.

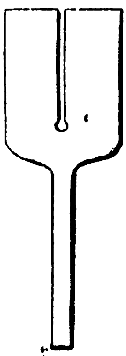


No. 1.



No. 2.

Sketch No. 1 represents the "stock" used, which consists of a piece of steel boiler plate, 3 inches long, 1½ inches wide, and 5-16th inches thick.



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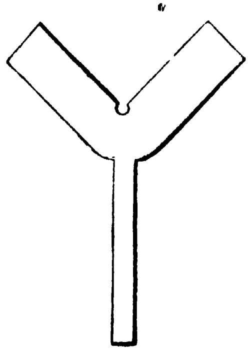
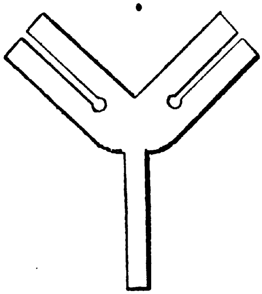


No. 4.

No. 2 shows the use of the "fuller," followed by "drawing" the shank to a uniform size which shall fit the "grip" of the tongs. To save room, the shank or handle is made short in all the sketches.

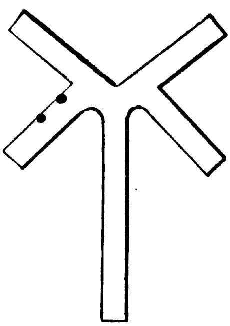
No. 3 shows the use of the "punch" and the "chisel."

No. 4 shows how the arms must be bent from each other so that they may be heated separately.

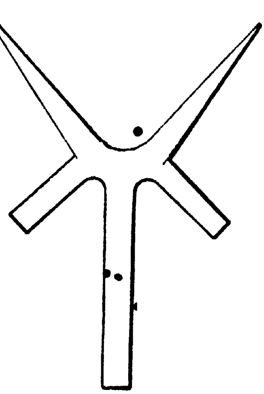


No. 5.

No. 5 shows how the arms are successively "punched" and split.



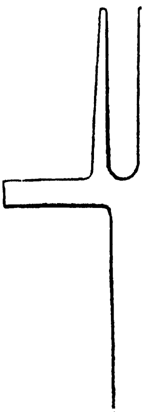
No. 6.



No. 7.

No. 6 shows how the outer prongs are bent away so that the inner ones may be heated and finished separately.

No. 7 shows how the inner prongs are "drawn" to their final dimensions any spare material being cut off.



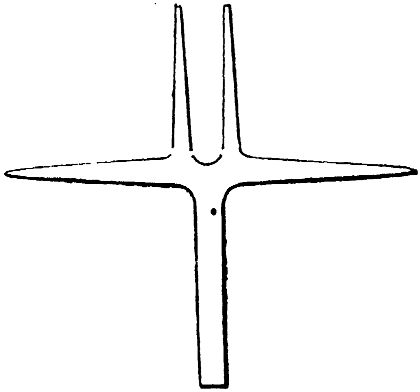
No. 8.

No. 8 shows more bending by which the inner prongs are finally adjusted, and the outer ones are brought into positions for heating.

Nos. 9 and 10 show that the outer prongs have been drawn, bent into position, and cut to proper length.

No. 11 shows how the shank itself, after having served its purpose in affording a working handle, is in turn heated, drawn, and flattened to its final shape.

The total number of heatings, more or less, is from



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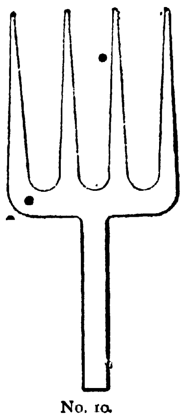
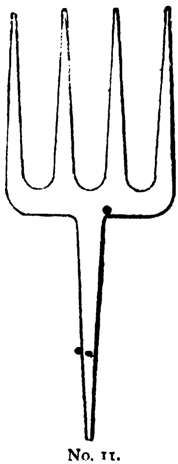


No. 10.



No. 11.

sixty to eighty. When I asked the boy who made these pencil sketches for me how many times the steel went into the fire he sat down, sketches in hand, and deliberately went over the entire process in memory, and counted nearly eighty heats. More practice would enable him to diminish the number.

It is possible that the reader who has thus far followed me may flatter himself that he "understands the exercise perfectly," and that he would gain little in knowledge of either principles or methods by actually executing the piece. If such is his thought, let me say that he is almost as far off the track as Dr. Brooks himself, and that a boy who has successfully "done" this steel fork, has a knowledge of it as much superior to that of a mere reader of this note, or of an observer of a finished fork, as a veteran soldier's knowledge of war is superior to that of a mere reader of Tactics and Grand Strategy.

CHAPTER XIII.

RELATION OF MANUAL TRAINING TO BODY AND MIND.

THE mother of a Philadelphia boy said last spring to the principal of the Philadelphia Manual Training High School, "I just want to know if I can carry a bed down and let my boy stay at your school all the time; for he doesn't want to come away, and he wants to leave home every morning right after breakfast." Substantially the same story of deep interest has been told me hundreds of times during the ten years since the St. Louis Manual Training School was opened. And this interest is no "craze," no ephemeral enthusiasm. The newness was worn off the broom long since, but it still sweeps wonderfully well. In many instances the third of three brothers rejoices as steadily in the work of the school as did his elder brother years ago. Some scraps of parental testimony I shall give later on.

In speaking of the relation of manual training to the mind and body we are all forced to make comparisons. If the new system has no fruit which the old does not yield, if it fails in valuable results where the other succeeds, or if the new product does not on the whole outweigh the old, then the new has no sufficient excuse for being.

In making these comparisons, my strictures will not indicate hostility. Our best critics are our friends, for their criticisms cannot be explained away on the ground of unfriendliness. In pointing out defects, or in quoting others who point them out, I am not attacking the public school, or classical schools. The physician who tells his patient what is the matter with him, and how to improve his condition is not attacking him; he is only preparing the way for a better regimen.

I shall not go into an elaborate discussion of what the schools ought to teach, in order to fix our standards of excellence. I shall assume, however, that we are aiming at universal education, that the boys whom manual training should help and strengthen are all the boys who are growing up to manhood. I am not thinking alone of the few who are to be trained to leadership, while the many are to be left untrained to fill the great army of directed workers. I am not thinking of one boy in twenty who is to be trained in theory while the nineteen are to be left to practical labour, having the one to lay out their work for them and to do all their thinking. Is not our aim to make men self-directed, self-determined, and therefore free? So long as one is educated only by proxy; so long as another is to perform his calculations, to make his drawings, to design his forms while he slavishly executes as directed, so long we can lay no valid claim to be a free people.

The proper education of to-day is a preparation for the duties and responsibilities of life. Our

students must therefore come out of school with the elements of high character, with a vigorous, healthy body and mind, able to put both hand and brain to work, to enter readily into sympathetic co-operation with the institutions of their country and time, Practical accomplishments are essential to a good education though they are not the whole of it. While training to the full the faculties of the individual, including his mechanical powers, and fitting him to act his part as a citizen, a home-builder, and a bread-winner, we must not fail to set high value on the finest products of the human mind, and to give fair introduction to the great fields of art and philosophy.

I do not wish to spend much time upon definitions, yet I am forced to declare that many educators have erroneous ideas as to what manual training is and what it aims at.

Before proceeding to give the results of actual experience, it seems to be necessary to say that the St. Louis Manual Training School is now closing its tenth year of regular work. It will graduate its eighth class in June next. Its enrolment for the year 1888–89 was two hundred and forty-one boys, in three grades. The minimum age of admission is fourteen years. The requirements on entering are substantially those of good high schools. All students take the full courses in mathematics, science, drawing, and tool-work in wood and metals. In language and literature the students elect between a continuous course in English, history, rhetoric, civics, and

political economy, and a course in Latin and French or German, with a weekly exercise in English literature. The number of present graduates is nearly three hundred.

I now propose to present some new evidence from the most reliable sources of the practical influence of manual training. It comes from those who have had the very best opportunities for observation, and whose deep interest in the matter does not usually blind their eyes to a school's faults. Parents are valid witnesses. Here follows my circular of inquiry:—

"TO THE PARENTS OF PUPILS IN THE MANUAL TRAINING SCHOOL.

"*January* 28, 1889.

"I have been invited to lay before an important body some facts in regard to the influence which manual training has upon the health, growth, and proper culture of both mind and body.

"No person can be more observant on these points than parents, and no others are so able to make just comparisons between manual training schools and other schools. Will you not, therefore, aid me by writing fully and freely on these points? I have no wish to make a case against any of the excellent schools which are naturally the generous rivals of this school. Neither have I any desire to cover up any of our sins of omission or commission. Tell the truth plainly, and I will quote you whether you speak for or against our system.

"The question of moral influence is not now raised; but if you have any decided views it may be of value in other discussions to have you give them now.

"Respectfully,

"C. M. WOODWARD,

"*Director.*"

I give a few of the responses, taking them in

exactly the order in which they came in. The writers will be found to tell their opportunities for observation.

No. 1. "My observation of its effects upon my son is that your system of manual training results in accuracy, facility of adaptation of means to ends, and self-reliance, such as in my judgment the ordinary course does not produce."

No. 2. It is "favourable to his physical growth and development."

No. 3. "I have not words to express our satisfaction at his mental development in the same time (five months). There is absolutely no loss of time in the Manual Training School. I note the benefit of your system in application to study, ambition to succeed, and in steadiness of purpose. I remark a wonderful development of these traits in our son since he entered your school. I am comparing your school with three others with which I have had experience. I am compelled in simple justice to express my preference for your school."

No. 4. "I have a son in the second year. I am greatly pleased. The progress in book study is so good, largely by reason of the fact that zest is maintained and tedium avoided by the alternation of book study with shop-work. Healthy growth and culture of the mind are promoted by the preservation and improvement of bodily health consequent upon the activities of the shop hours. The exertions of the shop-work of the Manual Training School have the best quality of a sanitary gymnasium. Frequent, non-fatiguing, regularly-recurring, health-giving exercise secured through a pleasing attention to ulterior objects, attractive and useful, yet totally dissevered from solicitude on health account. The outcome of shop-work is a faculty of thinking about means and methods."

No. 5. "My son is benefited physically, is more systematic and regular in his habits."

No. 6. "I consider the Manual Training School the best

regimen any boy can have to insure him development of brain, muscle, and morals. The system works admirably in all respects."

No. 7. From a lady educated in high school and college :—

"My brother entered the high school at the age of fifteen, a rather unhealthy and an exceedingly indolent boy. The school offered him no special incentive to work, and his year there was of small value. The next year he entered the Manual, and he has been working with renewed interest, not only willing to continue there three years, but inspired to go to college.

"During his first year at the Manual he was under the care of a physician. The physician acknowledges Fred's bodily improvement, but declares that his patient's brighter eye and happier face are due to his treatment, but I prefer to think that manual exercises and interesting work have been better tonics than the irregular and occasional treatment of the physician.

"Until he entered the Manual Fred was not my equal in mathematical power. Now he not only sees special cases more quickly and more clearly, but his mind has been trained to compare one case with another, and so to generalize. In gaining those conceptions so necessary to a knowledge of analytics and physics, I was especially deficient, because my mechanical and mathematical imagination had been poorly trained. I feel that I can testify that his has been well trained, and I know from association with manual training students in Washington University that this is generally the case with them.

"One of the greatest advantages of the Manual is that the work appeals to a practical boy and keeps him at school in spite of the fever to stop and make money, which attacks all boys at a certain age."

No. 8. "My son attended several good schools in other cities, but in none were the results anything like as satisfactory as in this school. It appears to his mother and to me that both the mental and physical influence have been very beneficial."

No. 9 has two boys in school; one will graduate in

June; one entered in September last. He criticizes high-school graduates severely and then adds:—

"I cannot as yet tell whether the training in your school will send out my sons better fitted for life's work than the graduates of the high schools have shown themselves to be; but I find in them much cheerfulness and ambition in the pursuit of their studies; I notice a healthier colour in their cheeks, more sparkle in their eyes, and a general physical improvement since they left city schools,—in themselves desirable results. I notice, also, that while their first reports showed much awkwardness in the use of their hands, they have gradually grown more skilful, as skilful perhaps as could be expected from boys whose ancestors were unfortunately compelled to do all their work with their heads, such as they were, and where there was not enough mechanical talent on either side to drive a nail straight."

This gentleman is the only one who criticizes the school. He thinks the boys should not be required to study at home after the full day at school.

No. 10. "This is John's third year. I have five more boys, and would like to have them all take the same course."

No. 11. The mother says she studied the effect of the school on other boys before her own were old enough to attend:—

"I have not been disappointed with the results in the case of my older boy (who finished his course last June), and now that the second is with you, it is an added experience of the value of that system of training. It has seemed to me that the education is more thorough, and better assimilated than in other schools. Elsewhere the manner of study seems to beget a distaste for books, either because there is an excess of them, or because there is a lack of practical application of what is learned. So emulation flags, and the boy is glad to get away from school.

"I can hardly speak too highly of your system. I must go a

step further and say that there is another element of success in it which is the moral tone which gives it its beauty and adorns it most. Probably there is no better evidence of this than the positions which the young graduates have taken and held almost at their entrance into life. They show the confidence reposed in them by their employers."

No. 12. "My eldest son was among the graduates in 1884. My second son will probably graduate in June, this year. I saw a marked improvement in the health of both in a short time after entering the school, not that they were sickly before, but there seemed to be a renewed vigour, and a daily increase of strength, caused by the manual training in conjunction with the mental discipline."

No. 13. "I am entirely satisfied with the progress made by my son at the Manual Training School, and what is equally as good in my judgment, *he* is satisfied and contented."

No. 14 is himself a graduate. He writes:—

"Had the first graduate (entering the employ of a large manufacturing company as draughtsman) done unsatisfactory work, the services of a second applicant would have been rejected without test. But the fact has been demonstrated to the contrary; the result is that Manual Training School graduates have the preference."

The company has employed six or eight of our young men. This same writer goes on to say:—

"I wish to emphasize one advantage which, in my mother's opinion, the Manual student has over the ordinary apprentice—'The former learns from the experience of others, the latter only by his own.'"

No. 15. "The Manual Training School is superior to other educational institutions. I base my judgment upon the wonderful improvement my own son has made in all his studies since he entered the school. The improvement is not only marked in his studies, but deportment and health."

No. 16. "I cannot speak in terms too high of the benefit which my son has received from the Training School. The course of instruction seems to have enlarged and broadened his mind in a way which, I am satisfied, at least in his case, would not have been accomplished in any ordinary school. I cannot dwell too much, also, on the benefit which has accrued to his health. At the time of his entrance he was outgrowing his strength, and I felt extremely doubtful about his continuance at school, but the exercise of the shop seems to have developed and strengthened his general constitution to a most remarkable degree."

No. 17. "I note a rapid and marked improvement in him in many ways. I am highly gratified at the progress he has made. He speaks enthusiastically of the school."

No. 18. Dr. G—— speaks of the rapidity and thoroughness of the education given his two sons :—

"They have acquired as much general education in three years as they would have gained in six elsewhere. One point in your system I wish especially to commend is the interest the boys take in their studies. While at the public schools, it was one continual drive to get lessons learned. Since my sons entered the Manual Training School I have never had to say, 'Boys, it is time to learn your lessons.' Had I forty boys I would send them all to the training school."

No. 19. A student of a technical school wrote me of his vacation work; he had graduated from the Manual two years before. He tells me of his success in a draughting-room and in the Exposition, and adds that—

"One of the most valuable fruits of manual training is the habit of systematic work. I mean the habit of laying a definite plan before starting upon a piece of work or action."

No. 20. Probably most school superintendents have seen the interesting reports of Superintendent Cole

of Albany, and Superintendent Compton of Toledo, touching manual training in their respective high schools. The latter publishes a significant letter from a prominent citizen of Toledo, a close observer of men and things, and a fearless critic. I will not quote his strictures upon the ordinary high-school graduate, but will give a single sentence from his estimate of the graduates of the Scott Manual Training School. He has had six or eight of them in his employ. He says :—

"The power of observation and concentration evinced by those young men has been most satisfactory, and I believe the advocates of manual training do not overestimate the value of such instruction as is furnished in your school, in securing the largest measure of mental discipline and power of application and concentration."

No. 21. This father, speaking more particularly of the physical influence, says :—

"Manual training has exerted a very salutary influence upon the general health of my son, Robert, who was constitutionally delicate and slender. While in the public school he was daily complaining of general debility, exhaustion, and lassitude. The reverse has been his experience under your system of training, for while he has a total absence of former complaints, he has gradually improved in physical vigour and endurance and has consequently applied himself to study with more zest, ambition, and pleasure."

No. 22. This response, with which I must close the testimony of parents, is signed by both parents, and is evidently a joint production :—

"Our third boy is now in the second year of the Manual Training School. The two older boys have taken the full course,

and the fourth is hurrying up to get ready to go. We have not at present any idea of telling him that we think he can do better somewhere else.

"During these years we have visited the school and have talked with friends whose boys attend the Manual, and with other friends whose boys go elsewhere or not at all. These latter tell us that our boys are exceptional; that neighbours all around are having trouble to keep their boys at school.

"We think that the boys at the Manual think less about 'trades' than the 'average boy'; rather the thought tends towards scientific pursuits—seeking truth for truth's own sake; for, so far as their experience goes, if they know a truth, they can use it."

I might continue such testimony indefinitely, but this must suffice. I can truthfully say that there is but one opinion in St. Louis as to the influence of manual training. There are in the city over two hundred of our graduates, and their careers are watched with no common interest. I respectfully refer the record of these graduates to such men as Mr. Buehrle, of Pennsylvania, who is so sure that manual training is to produce a "degraded mass of operatives," and to President Gray, of Minnesota, who prays so fervently against manual training.

PSYCHOLOGICAL CONSIDERATIONS.

No one will suppose that I put forward other witnesses because I have nothing to say for myself. I suppose I have observed more and thought more about the peculiar influence of manual training than any parent in St. Louis. It is because I have had so much to say, and have on other occasions said so much, that I now let others speak. But I should

like to state briefly the influence of manual training upon some of the faculties of the mind.

The first and greatest faculty to be trained is sense-perception. Here the influence of manual training is in every way remarkable. In ordinary vision not 1 per cent. of what falls upon the retina is perceived by the mind. In true perception, as Dr. Harris has clearly shown, all the figures of logic, and consequently all the faculties of the mind, are consciously or unconsciously called into service. Knowledge and experience and memory and generalizations are necessary to the operations of logic, and manual training is particularly strong in furnishing the knowledge and experience, in establishing the major premises essential to logical reasoning. Tool instruction and tool practice are full of meaning, and should always be strictly logical. Moreover, several senses join in the search for truth. Sight and sound and touch and muscular force testify together; the memory is called upon for former experiences; the new and the old concepts are compared and classified, inferences are drawn, generalizations are made; the newly-discovered truths are recognized as such, properly labelled, and packed away in the store-house of memory, to be ready for service in future discoveries. In sense-perception one re-enforces his present by all his past experiences. The richer and more varied that past experience, the deeper and wider his perception. A man without personal experience of the external world perceives nothing outside himself. A person

devoid of experience with the manifestations of force has no conception of cause and effect.

Manual training multiplies opportunities for personal experience and contact with external realities. One gains not by personal experience alone. The experience of the race is recorded in established methods and in the appliances of practical arts. The antiquarian sees in a flint arrowhead a chapter of ethnology; in a rusty coin an era in classical history. What must the student of civilization see in a circular saw, an engine-lathe, a locomotive engine, in an ocean steamer? To the untaught and inexperienced the arrowhead and the coin are refuse; the saw is a frightful and dangerous thing; the lathe is a stupid machine, which does work with precision because it cannot help it; the locomotive is an awful and inexorable mystery; the ocean steamer is a grand and inexplicable phenomenon, as beyond explanation as the ocean itself. But give one a skilful teacher, with a knowledge not only of things but of the student mind, and all these exponents of human thought, these monuments of human progress, become transfigured; they are luminous with the bright records of past experience. The experience of the teacher is recognized and assimilated by the pupil on the strength of his own experience. Manual training labours to give the pupil the results of human experience along certain lines. The various laboratories of mechanics, physics, chemistry, and drawing give him a modicum of personal experience, by means of which he may

subsequently interpret and appropriate the experience of others.

INVENTION AND CREATION.

Perhaps the most striking and peculiar function of manual training lies in its availability for cultivating a capacity for executive work, a certain power of creatorship. Every manual "exercise" involves the execution of a clearly defined plan. Familiar steps and processes are to be combined with new ones in a rational order and for a definite purpose. As a rule, these exercises are carefully chosen and deliberately planned by the instructor. However, at proper times and in reasonable degree—not too early nor too often—pupils are set to forming and executing their own plans. Here is developed not a single faculty, but a combination of many faculties. Memory, comparison, imagination, and a train of reasoning—all are necessary in creating something new out of the old.

This power of invention, of creation, is the highest active power of intellect of which we are capable. There may be three stages in the entire act of creation, viz.:—(1) The thought is conceived and elaborated in the mind. (2) A more or less imperfect representation of it is effected through the instrumentality of words, gestures, drawings, or models. (3) The full realization of the thought by actual construction. The infinite Creator omits the second step; He does not need it; but no finite mind can dispense with intermediate steps. A

drawing or a model helps to define and complete the thought. This is strikingly true of novices. In like manner as the drawing gives precision of thought, so actual realization compels revision of the drawing and a re-casting of the thought.[1]

Now, however we may grade these steps in the order of intellectual dignity, it is clear that they are all necessary. It is not claimed that the executive and inventive powers cannot and ought not to be measurably cultivated before the manual training school is reached. My present point is that in the manual training school these powers find continuous and systematic training in the various forms of manual work.

It is scarcely necessary to add, that while constructive tool work furnishes the training just referred to, the analytic work of natural science (botany, zoology, chemistry, physics, &c.) does not furnish it. This remark is not to be interpreted as in any way derogatory to the study of science in all schools. The study of science has its high and peculiar functions, but it is not my object here to present them. It must suffice to say that manual training and natural science work are supplementary essentials.

[1] It must be remembered too that drawing is one of the universal languages, and that, as the boys are taught to draw and then to execute, a mental discipline and power of seeing into space is learned, which makes it possible for them to see before it is finished just how the thing they are working at will look when it is done. Such methods can be applied to their ordinary school studies. Such concentration of thought is not so easily acquired in any other way as by manual training (Prof. Thomas Eggleston, New York).

If we omit the mechanical laboratory, we omit a valuable feature. It is one of the most fruitful for pupils just in their teens. Manual training is physics and art and gymnastics and mechanics combined. It keeps the young pupils alert. It stimulates thought and close observation. It feeds the natural appetite for mastery over material things and forces; it cultivates the taste; it encourages habits of system and precision and attention to details; it fosters the judicial characteristic of looking on all sides. It teaches one to see the end from the beginning, to lay plans, to invent, to create, to shorten methods, to economize time and material, to save labour; not, as some falsely suppose, for the purpose of avoiding labour, but that more may be accomplished.

One great end of education is to enable people to live over again the thought-lives and experiences of others as recorded in our civilization; but this can be done only by giving them a certain culture of experience along practical human lines.

The great fault of non-manual training schools is their haziness. The pupils look at multitudes of things, but do not perceive them. Having eyes they see not, and having ears they hear not. There is too much that is dim and muddy and feeble. Substances elude the grasp; shadows, uncertain and flitting, are too often the only result. The method which reason and experience both approve is reversed, and pupils are put to committing to memory matters which they are not prepared to understand; they are expected to profit by the

recorded experience of others before they have been properly trained in the school of experience themselves. Such treatment is naturally distasteful, and when one's school life consists too largely of it the school itself becomes irksome and unattractive. Even the memory is sluggish, so faint and lustreless is the mental impression. The keen relish of a manual training boy for both book and laboratory work is wanting.

It is useless to claim that it is the boy and not the school that is at fault when a healthy boy fails to take an interest in his school duties. It is common to insist that the boy has no brains, or is lazy. The charge is generally false, and the manual training school has proved what I say over and over again. Boys reported dull in other schools as well as those reported bright and industrious have awakened to new life and enthusiasm in our school, and that life has extended into all our lines of work. There comes a time in the life of every boy when he craves with an irresistible appetite what may be called food for his physical nature; when the senses are most acute; when he is exquisitely conscious of his growing strength, his increasing power over the external world; when his budding manhood opens the door into the great workshop of nature, and he is satisfied with nothing less than actual contact with concrete forms and tangible forces.

At this period the records of the past have little interest for a healthy boy. He must feel and act for himself; he must turn the key with his own hands,

and himself unbar the gates. He has no natural appetite to destroy; he destroys because he cannot create. He can destroy without being taught how; but how to build, how to construct, how to create he does not know; there he requires instruction, training, system, and they yield the keener pleasure.

The boy demands reasons, and arbitrary, unmeaning rules are extremely distasteful. Until he has a basis of personal physical experience with which he may digest the experience of others, books have little meaning and are of little value.

Then is the time to give him manual training Give him his saw, plane, and chisel; give him his lathe, his forge, and anvil; give him his blow-pipe and his crucible, his magnet and his engine, and teach him their logic and their power. His mind will absorb them all with infinite relish. In their forms and uses he will read the thoughts of men for many generations.

Do not be anxious lest he have no opportunity to develop literary taste. There is not a single influence flowing from manual training which is hostile to good books. Our graduates are hungry for good books, and they profit by them.

We claim to train the whole boy, and the instruction in our school fairly justifies the claim. Glance at our daily programme of study, recitation, drawing, and tool-work. Counting both recitation and study, at school and at home, we have on the average daily two "hours" of mathematics, two of science, two of language and literature, one of drawing, and two of

tool-work. What I call an "hour" is about fifty minutes.

I have known many pupils of equal grade who give four-fifths of their time to language and literature, and the other fifth to either mathematics or science, while no attention at all is paid to either drawing or shop-work.

I know that some people consider such exclusive training in literature broad and generous, but I think they are doubly deceived. Not only is such training not broad, but even the literary training thereby secured is less vigorous and healthy than it would be if combined with such culture as tends to give proper meaning to the words and figures of speech. All our tropes come from the external world and every exercise in manual training reveals new force and shades of meaning in our household words.

The same is true of the influence upon literature of applied mathematics and practical science. As Superintendent Seaver of Boston has well said, a word is only an empty box till by personal experience one fills it with meaning. In this filling process manual training plays a most important part.

My conclusion is no longer a paradox, but the reasonable effect of clearly evident, natural causes, viz., that more mental discipline and valuable culture can be given by combining manual training with the study of mathematics, science, and literature than by omitting manual training and giving the attention exclusively to the other subjects.

CHAPTER XIV.

FALLACIES CONNECTED WITH MANUAL TRAINING.

THERE are several fallacies which prevail more or less extensively touching manual training, which I propose to deal with at this point. Some of them have been touched upon elsewhere incidentally and incompletely. They require primitive and close examination.

1. It is claimed that the idea of manual training is very old, and that it has been tried in countless instances and has always failed. The claim is false on both counts. Manual *training* schools are new; manual *labour* schools are old, and it is the latter which have failed.

A "manual labour" school is one where boys are put to work during a portion of each day, for the purpose of earning their living either wholly or in part. The work they do is merely labour, done not for education, but for income. There is no manual culture, no breadth of training, no lively interest in new methods, new principles, and new illustrations of physical and mechanical laws, but a dull, stupid, daily task. Such a school generally has a short period of partial success while some enthusiast has it in hand, and then it wanes away.

"Manual labour" schools have been founded as

semi-charitable institutions. They have been attempts to solve the problem: How shall a poor boy be enabled to earn his living and get his education at the same time? In my judgment there is no solution to that problem. We ought at once to recognize the fact that a good education costs money, and that every time we attempt to shift the burden of support upon children under seventeen years of age, we are guilty of cruelty and neglect. Of necessity, the form of labour adopted in these labour schools is that which involves a minimum of training and skill, and a quick return. The pupils learn some of the elements of a narrow occupation; but, on the whole, their education, whether mental or manual, is between very narrow limits. Such institutions have few points in common with a manual training school.

2. The second fallacy is that a manual training school is an industrial school. The sharp distinction between the two was pointed out in Chapter III. It is only necessary to refer to it again. The word "industrial" is an exceedingly indefinite term when applied to education, and in my judgment ought not to be used.

3. "A manual training school ought to afford opportunity to boys to thoroughly learn individual trades." This fallacy is a very dangerous one for the reason that it is so plausible. The argument in its favour is something like this: (*a*) It is found that a certain amount of shop-work is in every way wholesome to a boy at school. (*b*) There is time during the course of the school for a boy to learn a trade.

(*c*) A trade can be much better taught in a schoo where the necessities of business do not compel the manager to impose mere drudgery and useless repetition upon the young learners. (*d*) The surroundings of the boy learning a trade in a commercial shop are so very objectionable, that no boy of fourteen should be subjected to them. (*e*) The boy learning his trade can learn drawing, mathematics, science, and letters, neither of which would he get in a commercial establishment. The conclusion is that the school ought to teach him a trade instead of dissipating his energies by giving him smatterings of several very different kinds of work.

The argument is dangerous because every one of the reasons presented is a good one. If the points raised were the only ones to be considered we should be forced to accept the conclusion; but other things must be considered, and these other things reverse the conclusion.

(*a*) In the first place, very few boys wish to learn particular trades to the exclusion of all others. Many boys are ignorant of themselves, their aptitudes and capacities. It may be that they ought not to learn a trade; they need a substantial course of culture to enable them to find what ought to be done. If they actually learn a trade and go to work at it, as the French boys do, they are likely to stick to it whether wise or unwisely chosen.

(*b*) If the school attempts to teach full trades it should teach all trades, a manifest impossibility, yet otherwise the school would be guilty of fostering

some trades and discouraging others, and public and private interests would suffer. Only a limited number of men in a particular trade are needed each year. Our school would at best be as unfortunate as those impolitic institutions which, at public expense, flood the country with unnecessary lawyers and physicians.

(*c*) Finally, the scope of a trade is too narrow for educational purposes. The boy must be broadly trained before he decides upon his career, be it a trade or a profession, or neither. The apparent saving of time is a delusion. It may take longer to reach the right choice of occupation, and then to fit oneself thoroughly for it, but the result is far more satisfactory. A better choice and a more liberal training are strong points as opposed to a mistaken occupation and scant culture.

My conclusion is, therefore, not to go back to the old one-sided system, but to send a boy through the manual training school, reserving final decision till it can be made with open eyes; if then a trade be the choice, the boy is in a condition to learn it under greatly improved conditions as compared with the old-style apprenticeship, for he is now three years older, is well and broadly educated, and a year's service easily puts him ahead of any old-style apprentice.

4. The last fallacy I shall expose is that of manufacturing for the market. The great majority of people take it for granted, without reflection, that it would be both wise and prudent to require the students to spend the greater part of their shop hours

in actual construction of such simple articles as they can be easily taught to make. It is argued that there would be a double advantage in so doing—the boys would take more interest in the construction of articles which have intrinsic value than they do in making something which only serves to teach principles and afford practice; and then the sale of such articles would materially help meet expenses.

Such arguments are easily answered. When a boy has learned a process or mastered a tool to such an extent that he is capable of producing marketable wares, it is time for him to turn his attention to something else. His time is necessary for education, not for production. Then as to his interest in his work. There is no lack of it when a new tool or a new process is to be mastered. The interest he takes in the saleability of his work is short-lived; it soon changes to a protest and disgust if carried far.

My conclusion is that the more a shop becomes a factory the less it is a school. Instead of planning the shop to turn out merchandise, it should be planned to turn out well-trained boys. Clear-headed, intelligent boys should be the only article put upon the market.

CHAPTER XV.

A REPLY TO CRITICISMS.

THERE is every indication that the interest in the aims, methods, and results of manual training is spreading and deepening. Extravagant notions are being laid aside, and correct and reasonable views are taking their place. Persons who had supposed that there was nothing in it—that it was only a craze—are finding that there is something in it worthy of consideration and respect. Those wild enthusiasts who claim everything for it are gradually forming a class by themselves quite apart from those who are steadily testing every theory by careful practice.

There is, however, much confusion as to the true scope, meaning, and value of manual training. It is my sincere wish to do what I can to give trustworthy information on the subject, to the end that manual training may take its true place in education. Accordingly, I have gathered here certain reviews and discussions which I hope will be found useful. I do not present any full discussion of the economic value of manual training, but it must not be inferred that that value is not high. On the contrary, I think its great practical utility would be a sufficient argument for its introduction into certain grades of all schools, were its educational value much less than it is. But

its educational value is great as well as its economic and since I am now concerned in setting forth the former, utility arguments may be left to presen themselves. Many people, teachers and others, are prone to consider direct utility as unworthy of any place among educational aims.

This leads me to call attention to the universal tendency of public opinion to drive people and institutions into extreme positions. One college officer says that it is no part of the function of an institution that claims to follow a liberal course of study, to give instruction in any useful branch. If a branch of science is discovered to have direct practical value, or a line of research is seen to have positive professional worth, that is a sufficient reason for discouraging it. In a similar way it is taken for granted that in a technical school, everything which is not of direct practical value is out of place. There appears to be no institution in which practical and culture studies may be combined. In a recent paper Dr. Harris says: "There remains a permanently valid place for the manual training school for all youths who are old enough to enter a trade and who are unwilling to carry on any further their purely culture studies."—The inference is that if they *are* willing to carry on their purely culture studies, they should not attend a manual training school, no matter how many of such youths there may be nor how long their willingness may continue.—Is it not possible for culture and manual training to go on together? Some persons appear to think that it is not. Classically

educated people stare in wide surprise when one happens to speak of Latin and English poetry in the manual training school. With equal surprise they would hear of a Greek student giving a portion of his time to shop-work, or practical electricity. Certain studies admirably suited for both use and discipline are in small favour in both literary and technical departments of study—in the former, because they are too useful; in the latter, because they are too useless. Now, I claim that both exclusive and extreme positions are bad; the world is full of their evil fruits.

This prejudice, which is especially strong in higher institutions, is plainly seen in the attitude of some educators towards a manual training school. Because a portion of the curriculum has bearings which are distinctly practical, useful, and economic, it is assumed *first*, that the manual part is purely economic and not educative; and *secondly*, that all literary and general education is either omitted from the curriculum or reduced to a minimum. I greatly fear that these two assumptions may be strengthened by the Report on the "Educational Value of Manual Training," presented to the Council of Education in session at Nashville, Tenn., July 15, 1889. The Report was signed by Geo. P. Brown (of Illinois), S. S. Parr (now of Minnesota), J. H. Hoose (of N. Y.), and W. T. Harris (now Commissioner of Education).[1] This Report I propose to examine somewhat in detail, at least where I disagree.

[1] This Report was issued by the Bureau of Education, early in 1890.

The Committee "proposed in their report to inquire in what precisely consists the educative value of the branches taught in the manual training school." Yet in spite of this laudable purpose the reader will find that the instruction given in a manual training school receives but scant attention in the Report. He will find a large number of subjects discussed, which have no connection, or only a remote one, with the nature and purpose of manual training. There are homilies on Street Gamins, Arrested Development, Conduct, Illiteracy, and The Study of Pure Science, as though these were pertinent to their declared purpose. What I regard as misleading and erroneous in the Report is these fugitive side-discussions and incidental definitions. It is not so much what the Committee actually declare, with one or two exceptions, as what they lead the reader to infer, that is most objectionable, as I shall soon proceed to show.

It seems to me that one coming to the Report for information, with no previous clear notion of manual training, its purpose and its scope, must get from its perusal a widely erroneous conception of the nature and mission of the educational feature known as manual training.

I have no idea that there was any intention to mislead on the part of the writer of the Report, but that it is misleading I feel quite sure. Evidently the Committee had in mind the "uncompromising enemies" of public education fully as much as "the advocates of manual training." In the very first paragraph the Report declares that those two classes

are united. I think that a grave mistake. Manual training people have no fellowship with the enemies of public schools.

Under the cover of an attack upon manual training the Committee deals its heaviest blow upon those "uncompromising enemies" who oppose all literary education at the public expense. None of such blows actually hit us, but the unwary are liable to think that they do and that we deserve them. They naturally ask: "Unless the enemies and the manual people are under the same flag, why this attack on the opponents of spiritual education under the cover of the Educational Value of Manual Training?"

Now the people who are engaged in carrying on manual training schools are to a man heartily in favour of public schools; most of them are public school people, and they all believe in the value and necessity of literary and scientific training. But they believe in more than that—they believe in incorporating manual training in the higher grades, and they most firmly maintain that public education will thereby be improved.

I shall take up several points in the Report in a certain logical order.

I.—*The curriculum of the manual training school.* The Council Report says that "the entire curriculum of the manual training school," is included in "work in the trades that deal in wood and metals."

The vast majority of teachers and parents have never seen a manual training school; have had no chance to know what one is and how it is conducted.

These people naturally look with confidence to the deliberate utterance of a Committee of the Council the most august body of Educators in the land. One of the important questions of the hour is: What is the real value of a manual training school? Preliminary to this is the question: What *is* a manual training school? And this distinguished Committee says that the "Entire curriculum of the manual training school is included in the work in the trades!"

It is not easy to account for such a careless statement. It seems probable that having fixed their minds upon shop-exercises, they, for the moment, laid aside all thought of anything else. I shall recur to this point at a later stage of this discussion, but I cannot refrain from remarking that in this respect their report seriously misrepresents manual training schools. Let us call it a slip of the pen; they wrote "entire curriculum," instead of "the entire tool-work of the curriculum." But we do not expect such men to slip in that way.

Now what are the facts in regard to the curriculum of the manual training schools? I think I can answer for nearly every one of them :—

First. The curriculum gives one-half as much time to drawing as to tool-work.

Second. It gives as much time (study and recitation) to mathematics as to tool-work.

Third. It gives as much time to Science (theoretical and practical) as to tool-work.

Fourth. It gives as much time to language and literature as to tool-work.

No "trades" teach drawing, or mathematics, or science, or literature. All these things must be included to make up the entire curriculum of a manual training school. In confirmation, see the catalogues of the manual training schools of Chicago, Baltimore, Philadelphia, Toledo, San Francisco, St. Paul, Cambridge, and St. Louis.

In the face of these truths, how unfortunate the Committee's statement is! And as I re-read the entire report, I see that it was no slip of the pen. In numerous passages the reader sees the same statement assumed. I quote from the Report:—

"Your Committee understand that any amount of manual training conducted in a school is no equivalent for the school education in letters and science, *and ought not to be substituted for it.*

"The economic utilitarian opposition to the spiritual education in our schools, makes sure of his [the pupil's] inability to ascend above manual toil *by cutting off his purely intellectual training.*

"The *illiterate manual labourer*, no matter how skilfully educated for his trade in wood and metal operations, cannot read and write.

"To be excellent in manual training, would not prevent him [the pupil] from being *illiterate* and a bad neighbour and a bad citizen,—*even a dynamiter.*" [The italics are mine.]

They speak of the manual training school as a "school devoted to the business of educating the youth in the essentials of his trade or vocation."

There are other passages of similar import which the reader may readily find in the Report for himself. Now what idea of a manual training school is a parent or teacher to get from such passages as those?

We are bound to suppose there is some relevancy in them, yet if they are not as misleading as language can be, I do not understand my mother-tongue.

But the Committee may have knowledge which has been denied to me. They may have found in Illinois, or Minnesota, or Massachusetts, a manual training school either in existence or in prospect which has "cut out letters and science and all purely intellectual training"; where the boys are "illiterate, unable to read and write;" where the managers of the school are making sure of the boys' "inability to rise above manual toil" by "making their childhood a preparation for special industries," with a strong probability that they will become bad neighbours, bad citizens, and even dynamiters.

If they have found such a school,[1] their language has some justification, and I heartily join them in condemning it, root and branch. Let all who believe as I do in the value of cultured minds, as well as skilful hands, join in frowning such a school out of

[1] In answer to this charge of misrepresentation, Supt. Parr has replied :—

"Truth is not geographical in its boundaries. Fortunately it is not to be viewed as circumscribed by the corporation lines of great cities, like Philadelphia, Chicago, and St. Louis, whose manual training schools are cited as a larger truth against the smaller truth from country districts like Illinois, Indiana, and Minnesota."

This suggests that he has found in the country districts of these three States manual training schools of the very objectionable sort. I am sorry that such schools exist, but I am very glad that Mr. Parr has found them. Let us all hope that they may mend their ways. But Supt. Parr should be careful how he speaks of "country districts." I gave great offence once by referring to one of our most accomplished educational writers as a "country editor in Illinois."

real or possible existence, and do what they can to establish the general adoption of a rational curriculum. Meanwhile let the Committee amend their report; give credit where credit is due, and avoid the danger of being suspected of setting up a "strawman" for the exquisite pleasure of seeing it topple over under their vigorous blows.

Unless the Committee can justify their words by reference to some such obnoxious manual training school, we shall conclude that not a phrase only, but the greater part of their report was a slip, and should have been submitted under another title.

When the above criticism was made in the pages of *The Teacher*, the chairman of the Committee, Mr. Geo. P Brown, was constrained to reply. He ridiculed the idea that any one could be misled by their statement in regard to the curriculum. Of course, every one knew that manual training schools had more or less work in science and literature, but the educational value of such work was not under discussion. What was wanted was a definite statement and analysis of the educational value of manual training. Said he: "The Report was upon the educational value of manual training *considered by itself, disconnected from the study of letters and science*, and *without any regard to where it was obtained*, and the St. Louis School or *the education received in it was not in the minds of the Committee* while making it."

This is a most astonishing confession. Mr. Brown admits that although they claimed to inquire into th "educative value of the branches taught in th

manual training school," yet in writing their report no thought of the education received in the manual training school entered their minds. They did not even go into the schools to see what their tool-work was and how it was taught. On the contrary, they went outside, among manual labourers, where labour (not "training") was not complicated by a knowledge and study of science and letters. Taking Mr. Brown's confession and the Report together we see where they went. They went among the street gamins, and noted their stunted prematurity. They went into the factories which employ child labour, and almost wept over the deformed bodies and joyless lives of the helpless victims they found. They went among the illiterate craftsmen and enumerated the great number of things they ought to know, but of which they knew nothing. They went among the rioters of a great city, all of whom were "excellent in manual training," but wanting in all the characteristics of good citizens and good neighbours.

Then they returned from their inquiry and prepared their Report. Now, unless they have stultified themselves, they wish their millions of readers to understand that the evils they have witnessed—the arrested development, the deformity, the wretchedness, the ignorance, and the crime—are to be taken as indicative of the educative value of the manual training as taught in the manual training school. If they are not to be taken to mean that, then what in the name of reason are they to be taken for?

Hands without brains are as worthless as brains

without hands. Mr. Brown has been satisfied with the latter; I suppose it is in accordance with the law of extremes for him to expect us to be satisfied with the former. It is now evident that he believes that the processes and activities of manual training as taught in school, and closely associated at every step with science and letters, are identical with the mental and physical processes and activities of uneducated labourers, toiling for daily bread in commercial establishments.

This defence of Mr. Brown, that in order to observe the effect of manual training pure and simple, it is necessary to go among people whose *only* training is in the manual direction, has little in its favour. In the first place, there are no people whose moral, physical, and intellectual status may be attributed to manual training and to nothing else. Secondly, the sort of training that people get in practical work outside of schools cannot be compared in educative effect with the systematic and logical work given in tool-work and drawing in a manual training school. Thirdly, to find the educative value of a feature of school training, it must be considered as it is given in connection with other school work. It is utterly unreasonable and unfair to take it out of its environment. We do not test values thus in other matters. In estimating the value of salt as an ingredient of our food, it is not necessary to hunt up a people who eat nothing but salt, and observe its effects upon them. In determining the educative value of the study of Italian, it is not necessary to analyze the character and condition

of a swarthy native of Venice or Naples, selling fruit and peanuts at the corner, or vending plaster images from door to door. To be sure, his education is limited to an unscientific knowledge of his native tongue, and may be held to be free from all other branches of culture, and we may pay no "regard to where it was obtained."

I insist that the influence of manual training in school education shall be studied under the conditions in which it is given in education. There is absolutely no question about its educative value under other conditions. We are discussing schools and school work, and nothing else. If the influence of manual training, as it is taught in manual training schools and in connection with all the other school work, is not yet sufficiently manifest in the lives and characters of those who have received it, then let us not attempt to give it by reasoning from effect to cause. Leave that phase of the discussion till adequate data are at hand, and confine the present discussion to an analysis of the character and content of manual training, and, reasoning from cause to effect, determine its influence upon the minds and characters of schoolboys.

It may be answered that the Report gives such an analysis and such a course of reasoning. Such a claim I should flatly deny, for the processes it analyses are those of factories and not of schools, and then, for the most part, it attempts to determine the influence of such factory methods on illiterate, unscientific people. But the difference between school work and factory work needs to be set forth at length.

II.—*School tool-work* vs. *trade-work.* Assuming that the Council Committee meant the "entire tool-work of the curriculum," let us compare it with trade work. Let us see if it is all "included in trades that deal in wood and metals," as the Report would have us believe.

It is true that all our actual tool-work is included in trade operations, just as all arithmetic is included in the business of the grocer, the jeweller, the druggist, the banker, the plasterer, &c.; and as all natural science is included in the work of engineers and manufacturers. These are strong points in favour of tool-work, arithmetic, and science. If there were no use, no applications of arithmetic in life, it would be as little taught as is Chinese.

But the converse statements are by no means true No trade is included in our tool-work, just as no occupation is included in science and mathematics. Let me dwell a moment upon the striking difference between our work and ordinary trade work.

The false statement most easily made and most often heard is that the manual training school aims to turn out carpenters and blacksmiths; and the Report encourages that notion by admitting "in the outset, the reasonableness of substituting a system of manual training in special schools for the old system of apprenticeship."

Suppose a man learns the trade of a carpenter, what does he learn to do? He learns to lay a floor, to make a panel-door, to build a cornice, to shingle a roof, to construct a picket-fence, to build a flight of

stairs, to put in headers in floor joists, to frame a barn, and to cut rafters for a hip-roof. Unless he can do all or most of these things, he is no carpenter. Our students, as a rule, never do any of these things. The joinery, wood-carving, wood-turning, and pattern-making we give our students have small reference to particular trades, though as the exercises deal with the theory of tools and, with the elements of construction, they may be said to underlie a score of trades.

But the fact that at every stage of our work drawing is interwoven with the use of tools, and the fact that attention is always called to what is general and what is special in the exercise, make our wood-work a different thing from the work of any industrial establishment.

Similarly a worker at the forge and anvil can scarcely be called a blacksmith till he has skilfully made and set a horseshoe, welded and fitted the tire of a waggon wheel, forged and sharpened heavy drills, and made a certain number of bolts or nails in an hour.

We aim to do none of these things, so that gauged by such a standard our students are acquiring something very different from blacksmithing. They fairly learn the *principles* of metal forging, and they have had just practice enough to enable them to thoroughly understand and appreciate those principles. They know, for instance, that when the thread-end of a tie-rod has been enlarged by up-setting, the rod is stronger than when a larger end has been welded on

instead; and they know *why* it is stronger, and their knowledge has a quality about it which is altogether lacking in the knowledge one gains from reading such a statement in a book.

But some one will ask, is not this knowledge of principles, and this personal experience valuable to one who does subsequently learn the full details of a metal trade? Of course it is, immensely valuable; in fact, I do not see how any really intelligent and successful worker can get on without it; nor can I conceive of any reasonably active mode of life, in which this knowledge and experience would not be of great value as a species of practical science culture.

The second error, then, to which I would call attention is that of regarding the shop-work, which is appropriate for a school, as adequate for apprenticeship. If at the age of 17, 18, or 19, the manual graduate desires to learn a trade, he must still serve a brief apprenticeship in a strictly trade establishment where not principles, but definite practices are taught. But this he can do with numerous and important advantages on his side. His knowledge of drawing, of science, of mathematics, of letters, and of the fundamental principles and processes of construction fit him for speedy leadership among the old-style, uneducated mechanics.

III. *The age of manual training school pupils.* In the very beginning of their Report, the Committee propose "to inquire in what precisely consists the educative value of the branches taught in the manual

training school." They say that they will "treat incidentally also the economic questions involved."

After assuming that the "branches taught" consist exclusively of trade work, and conceding their superiority to the old style of apprenticeship, they "insist that *such manual training* ought not to be begun before the completion of the twelfth year of the pupil."

Incredible as it may appear, the Committee *insist*, as though in the face of some determined opposition, that boys shall not devote their time exclusively to learning trades *before they are twelve years old!* For the sake of emphasis they repeat:

"They hold the opinion that neither apprenticeship nor the industrial school should be allowed to take possession of the youth until the completion of his twelfth year at least; the fifteenth year is still better, because physical maturity is necessary for the formation of the best muscular movements to produce skill. At too early an age the pupil with his small hands and fingers, his short and undeveloped arms, is obliged to acquire bad habits of holding the implements of labour. Moreover, the serious occupations of life cannot be imposed on children without dwarfing their human nature—physically, intellectually, and morally—and producing arrested development. Not only the games of youth, but the youth's freedom from the cares of mature life should be insured to him if the best preparation is to be made for manhood."

The Report then dwells on the sad spectacle presented by the unschooled children of the very poor, the street gamin, and the premature old age of those whose childhood has been usurped by suffering and care.

As I said in reference to former quotations, we are bound to suppose that all this has something to do with manual training and the manual training school.

The Committee does not say outright that manual training schools are attempting to teach trades to children not twelve years old, but they plainly give one to understand that they do, and that these dreadful evils are likely to follow as their legitimate fruit. Unless these evils exist or are imminent in our manual training schools; unless those schools do cramp the small hands and fingers, the short and undeveloped arms of tender children, dwarfing and stunting both body and mind by hard labour, premature care, and cheerless drudgery—why does the Committee interpolate the sad picture? Did they consciously or unconsciously hope or expect that, because we all condemn cruelty and injustice to children, we should be led by this juxtaposition in their report to condemn manual training schools also?

I suspect that my readers, who have seen the Report, and who have obtained from it some notions of the institution, whose educative and economic value the Committee set out to investigate, will suffer no small surprise when told that not only is there no physical, intellectual, and moral dwarfing in the manual training school, no imposition of the serious occupations of life, no lack of joy and cheer, but that no manual training school that I know of admits pupils till they are thirteen or fourteen years old.

The usual age corresponds to the ninth year in school; in some cases it is the eighth year or possibly the seventh, provided the boy be thirteen years old. The average age of the 100 boys who form the "first-year class" of the St. Louis Manual Training School, and who were admitted on the 16th of September, 1889, was 15 years 11 months. The youngest boy in the class was 13 years 8 months old. In the manual training schools of Chicago, Philadelphia, Cleveland, New York, Cambridge, Indianapolis, Albany, Minneapolis, and San Francisco, the age is about the same as in my school. In those of Baltimore, Toledo, Omaha, Springfield, Mass., New Orleans, and St. Paul, the age may be a little less.

Manual training schools are springing up so rapidly (that is, public high schools are becoming manual training schools in so many cities and large towns), that I cannot speak definitely of many of them. The Commissioner appointed by the Governor of Pennsylvania to investigate the subject of manual training as related to public education reported in favour of the introduction of manual training (shop-work and drafting) into all the high schools in the State.

I do not ignore the fact that the country is full of insane people, and that not a few indulge in educational vagaries. Perhaps the Pedagogical Committee have come in contact with some of them, and have mistaken them for manual training school people.

I have met some of these mad people. They

always find much fault with us. They think we might do and ought to do numerous things that I know very well we cannot do, and would be very foolish to try to do. These erratic people generally are unfamiliar with scientific methods of teaching, and ignorant of what trades really are, and the conditions under which they may be adequately mastered.

It may be objected that the Committee were dealing with the question of manual training in all the grades as it has been introduced in some cities, and as it has been urged by excellent people for all cities. Of course I cannot know all that has been done in the name of manual training, but so far as my acquaintance does extend the manual training work which has been tried in the lower grades (of New Haven, or Montclair, or New York City, for instance) is as far as possible from "trade work in woods and metals." The exercises consist only of paper-cutting, drawing, clay-modeling, whittling, and a few simple exercises in joinery with the older classes. There may be a little turning, scroll-sawing, and filing, but it is too little to justify any of the assumptions of our Committee. So far as I know the views of teachers who have had actual experience with regular tool instruction, I am able to say that they are almost unanimously opposed to giving shop-work to boys less than thirteen years of age.

In conclusion, I challenge the Committee to point out a single school in the United States, manual training or otherwise, where pupils not twelve years

of age are set to learning trades. If they cannot do so, it will be in order for them to explain why they devote so much time and space to an essay on "street gamins," "child labour," and physical deformity, and to insisting that we shall not do what no one has ever done, and what no sane man wishes to do.

IV. *Social evils as related to manual training.* In continuing my criticism, I wish to say that there are many things in the Report which I should heartily approve were they removed from all connection with the discussion of manual training. Take, for instance, a long passage in which the Committee answers the question: "What does one need to know besides his trade?" They answer correctly and well under these heads: Behaviour towards Fellow-Workmen, Employers, Neighbours, Family, Children, Fellow-Citizens, Votes, Voters; Evils of Illiteracy; Victims of Agitators; Geography, History, Literature.

Why, of course! It goes without saying that there is no difference of opinion among respectable people on these points. But in what way does such a discussion bear upon the educative value or economy of manual training?

Could they not with equal force and propriety discuss the needs of personal cleanliness, the care of the teeth, diet, the use of tobacco, whisky, &c.?

I suppose the Committee will reply, at least in thought, that these matters are not in any peculiar

manner related to manual labour, while the evils they point out are characteristic of labourers and craftsmen.

Possibly they are—but still I ask, why was the point introduced? Had the Report been written to set forth the educative value of the study of the Greek language, this disquisition on Social Evils would have been just as appropriate as now. The passage referred to appears to be introduced to point out "a fatal omission on the part of the economist," who claims that "the schools should fit the child for his future duties in life."

We are not told who the "economist" is, nor is it shown that in truth he makes the "fatal omission," but we have here a clue to the Committee's reason for presenting their homily on Conduct: *First*, they assume that the economist is asking for the manual training school; and *secondly*, they assume that the manual training school is an institution to multiply labourers and craftsmen of the sort who know nothing besides their trades. In other words, they have gone into the pin-factories, plough-factories, and forge-factories, the street mobs, and into the jails of Chicago, and they have said: "These pin-makers and plough-handle turners,[1] these black-

[1] A word of explanation is necessary here. Mr. Brown is the editor of a school journal, and he has naturally discussed manual training in its pages. Once he wrote :—

"A man in one of the manufacturing towns of this State has been turning plough-handles for twenty years. Day after day his life has been one monotonous round of toil. Ten hours per day for twenty years has matured the turning of plough-handles into a mental and

smiths, these illiterate, bad neighbours, and these dynamiters are manual labourers, and they typify the legitimate fruit of manual training and of an attempt to fit boys for their future duties in life!"

The magnitude of the Committee's error in all this is past measuring. Those unfortunate men exhibit the fruit not of manual training school education, but of a want of it. If they are the fruit of anything, they are the fruit of that system of education which has prevailed ever since they were born, and which our Committee would fain have us be contented with as adequate to all communities and to all times. Instead of trying to bolster up their attack upon manual training by an enumeration of the shortcomings of those ill-trained people who unquestionably make up the mass of labourers in this country to-day, they should see that had manual training schools been as numerous during the past thirty years as have high schools and academies, the evils they complain of would be much less than they now are.

This for two reasons: (1) The number of boys carrying their education forward into their teens would have been vastly greater than it has been with-

physical habit which dominates and even constitutes his life. When two-thirds to three-fourths of the curriculum of lower grades, and one-half of the higher is devoted to work akin to turning plough-handles, is it not a serious question whether it gives the preparation which that man most needs, that is to turn plough-handles all his life?"

If I believed, as of course Mr. Brown does, that the friends of manual training were labouring to bring about the condition of things pictured in the above quotation, I should oppose manual training so vigorously that I should put Mr. Brown's opposition to the blush.

out such schools; and (2) though not teaching special crafts, but general principles; giving a wide range of culture instead of aiming to put boys into trades and professions,—had the number of manual training schools been adequate to the wants of the community, three striking results would have followed:—

(*a*) There would have been a greater industrial development, particularly along new lines and into new fields, though the relative number of craftsmen would scarcely have been increased.

(*b*) The amount, variety, and quality of industrial products would have been greatly increased and improved.

(*c*) The average tone and character of our home-trained industrial workers would have been substantially raised above its present level; they would have been much better educated than they now are, for manual training means not less but more education.

This analysis does not include the benefit that would have accrued to other occupations, not industrial, from the wholesome training of the same schools.

Though the Committee set out to discover "the educative value of the branches taught in the manual training school," they have done no such thing; they have only taken up the question: What is the educative value of *ordinary manual labour with tools*, as practised by those who have had *no other education of any sort;* who know neither how to behave, how to read, how to draw, nor how to vote?

I therefore convict the Committee of a piece of most illogical reasoning, to wit: They condemn manual training schools on account of evils for which they are in no way responsible, but which, on the contrary, it is a part of their high mission to help remove.

V. *Manual training compared with the study of pure science.* The Report begins the discussion of the educative phase of manual training with an admirable statement:—

"The education of the intellect takes place through the ascent from one thought or idea to another; from a narrow point of view to a broader and more comprehensive one; from a vague and general grasp of a subject to an insight that explains all the details, and sees the relations of all parts to the whole."

I ask for nothing better than that on which to base criticisms. Equally good is another statement which I shall also be glad to use at another time. I insert it here because the two come side by side in the Report, and both are worthy of high praise:—

"The education of the will takes place by fixing and unfixing habits of doing."

The Report presents an argument based on science to prove that the intellectual education gained from manual training is of narrow scope and limited in time. The argument is of the *a fortiori* sort.

(*a*) "The study of pure science is more educative intellectually than the study of special applications of it."

(*b*) "The study of applications of science is more educative than the labour of making the machine."

Therefore, *a fortiori*, the study of pure science is much more educative intellectually than the labour of making the machine. This conclusion is not formally stated, but of course it is easily inferred. In proof of the first point, (*a*), the Report compares the study of the steam engine with "the study of the theory of heat and of the dynamics of elastic fluids." The second point, (*b*), rests upon the consideration that the maker of a machine adopts one design out of many, one material out of several, and "obscures his general view of the principle of the machine by covering it up with a great collection of details that do not essentially concern it."

The Report leaves the reader to make the application of this argument for himself. Of course it is to be understood that the manual training pupil is the maker of "the machine." It is not very clear what "the machine" is, but perhaps the steam engine is meant. It would also appear to be understood that the machine-maker does not study the applications of science beyond the limits of his particular machine, and that he gives no attention whatever to the general theory of heat and the dynamics of elastic fluids. Moreover, it would appear that the educational object of making the machine can only be to acquire thereby some view of the principle of the machine. The conclusion of the argument was explicitly stated by Mr. Harris, the writer of the Report, in closing the debate upon it. He said:—

"The purely manual work of the school belongs to the lowest grade, and furnishes the obscurest knowledge of principles covered up by a mass of non-essential circumstances."

There are many things to be said in answer to this argument. First, I will meet the Committee on their own ground, that of the study of science. In the second place, I will show that their ground is not our ground, and that in this case, as in many others, they have not yet divined the motive nor the content of tool-work.

1. The study of pure science, the theories of heat, pneumatics, hydraulics, electricity, chemical affinity, &c., are not omitted in a manual training school. Of course, the students are young and capable of only elementary work.

Moreover, the study of pure science is coupled with a large variety of special applications. Instead of debating the question which is best, pure science without applications, or applications without pure science, we have both, with a perfect assurance that the two combined are greatly superior to either alone. In the next place, our students make a great variety of apparatus to illustrate special applications of scientific principles. For instance, they actually make pumps, fountains, pyrometers, telephones, dynamos, engines, telegraphic apparatus, cameras, &c., &c. (Of course the more elaborate of these things are made as "projects" by individual students at the very end of their course.) And we find that their work with minute and exact details in real wood, iron, steel, brass, copper, leather, tin and glass, does not obscure

their general view of the principles of science, but that it makes it wonderfully clear. Their minds "ascend from one thought to another, from a narrow point of view to a broader and more comprehensive one; from a vague and general grasp to a clear insight." The narrow point of view must come before the broad one. The best possible beginning is to thoroughly master certain experimental phenomena, and the best way to know an experiment is to know the apparatus root and branch.[1]

Did Tyndall, or Faraday, obscure his view of science by manufacturing his own apparatus? Did Edison obscure his view of the theory of electricity by manufacturing his hundreds of devices with his own hands? Does the musician obscure his general view of the principles of music by the thorough mastery of a particular exercise or piece? Can any one have a comprehensive view of the whole unless he has a clear and comprehensive view of the parts?

Mr. Harris himself once said most happily, while comparing the primitive knowledge which one gets for himself with mere second-hand hearsay know-

[1] Speaking of the apparatus used to illustrate the principles of science in school laboratories, Prof. John F. Woodhull says: "Most pupils of high-school age fail to comprehend the machines, and their minds are only confused thereby with reference to the principles."

"As discussions about words can never remove the difficulties that exist in things, so no skill in the use of those aids to thought which language furnishes can relieve us from the necessity of a *prior and more direct study of the things* which are the subjects of our reasonings. And the *more exact and the more complete that study of things has been*, the more likely shall we be to employ with advantage all symbolic aids and appliances."—*Preface to "Boole's Differential Equations."*

ledge: "A very little primary knowledge is worth more than a cargo of secondary knowledge." All primary knowledge begins with details.

On the other hand, what confidence can one have in a mere theorizer? one who knows nothing of special applications? And if he has studied applications under ideal conditions only, where machines are purely imaginary, with imponderable, inextensible, invincible, and perfectly rigid or perfectly flexible material; if he knows by experience nothing of the details of apparatus made of real materials and used under actual conditions,—is he not lacking in many essential elements of a sound scientific training?

In my judgment the field of pure science lies far beyond the range of the manual training school, in the higher realms of the technical school. The pupil must creep before he can walk, and he must walk before he can run. In the manual training school we can hardly claim to do more than to help him to walk. His point of view is narrow, his horizon near, but if he sees clearly what he sees at all, and grasps firmly what he puts his hand to, he will with increasing strength and a broader vision "ascend from thought to thought," to a just conception of the scope and meaning of science.

My answer is, then, that, on the assumption that the exercises of the shop of the manual training school consist solely of machine-making, for the purpose of illustrating the principles and applications of pure science, their argument still does not touch

us, for our plan of combining theory and practice is a vast improvement over either alone.

2. The chief purpose of our shop-work is not the study of science as that phrase is ordinarily understood. The work I referred to above, that of constructing and using physical and chemical apparatus, is quite distinct from our regular course of shop-work. Of course, there is more or less science in all shop-work, for every mechanical process and the form and theory of every tool are based on established principles of science; yet the main object of shop exercise is not to gain a knowledge of those established principles.

Just here is the stumbling-block of many an inquirer. It is often assumed that we must have one or more of these three objects in maintaining tool-work in school, viz.:

1. To produce articles for the market or for domestic use.

2. To teach specific trades to those who wish or expect to follow them.

3. To teach and illustrate the principles of practical science.

Let me give the Committee credit for not holding the first opinion. I am not so sure as to their standing on the second point. As to the third point, the argument I quoted above appears to show that the Pedagogical Committee regard our tool-work as only a poor, narrow method of studying science.

None of the three objects are ours.

The primary object of tool-work (for there are

many secondary objects) is *to develop and strengthen productive activity by gaining a mastery over materials and certain conventional tools and processes.* What we shall do with our materials and tools after we have mastered them we do not particularly inquire. They are suited to abundant uses, and the active mind will need them a thousand times in embodying thought and in effecting other ends. The most sufficient method of arousing and stimulating the executive faculties is by giving one the sense of mastership over materials, forces, and appliances. One quickly desires to do what he first sees he has the power to do. The sense of mastership, of ability to smash, to break, to overthrow, which leads the undisciplined unskilled youth, to commit vandalism, may be converted into a sense of ability to build, to invent, to construct, to create; which leads to such things, as book-cases, dynamos, engines and cameras.

This conversion cannot be effected without teaching minutely what book-cases, dynamos, engines, and cameras are; and secondly, giving a mastery of the materials and tools to be used, and the principles of construction.

But while gaining this mastery, ulterior objects are kept out of sight, just as we keep the sonatas of Beethoven and the nocturnes of Chopin out of the sight of a child absorbed in the intricacies of scales, fingering, and counting exercises on the piano.

For example (and I think it best to be quite minute on this point, for here is where many fail to appreciate our methods), we teach the boy how to

grind his plane and oil-stone it, till it has a razor edge without flaw or feather. Then we teach him by precept and by example how to set his plane; to take it to pieces; to readjust it to the nature of his material; how to hold and push it so as to avoid unequal cutting on a side or at the end of a piece,—and all this without any particular thought as to what he will make with his plane when he has mastered it.

In a similar way he is taught the proper care and use of every tool on his list. He learns how to work with, against, across, and on the end of the grain, with all kinds of wood from apple and ash to walnut and willow. He learns how to treat a knot; how to use the brace and bits; how to avoid splitting when nailing, chiselling and boring; how to use try-square, gauge, and bevel, in accurately laying out mortises, dove-tails, &c.; how to hold his chisel and how to strike with the mallet; how to saw to a fit on the right or left of a line; how to match and glue, and polish, &c.

The pupil learns all these things abstracted from special applications. No lively interest in some proposed construction is allowed to "obscure his view" of the details of the work which must be mastered one by one. While making a joint, for instance, nothing is allowed to interfere with a full comprehension of its nature, its exact form and dimensions, and the order in which the steps of the process may best be executed. The question of what is to be done with the joint is not allowed to come in till he

has thoroughly learned not only to draw it, but to make it.

In these several respects we teach tool-work and the properties of materials just as we do the details of algebra. Addition, subtraction, factoring, equations, elimination, and so forth, are taught without much reference to the uses of algebra in the study of physics, mechanics, astronomy, and the higher mathematics. As a rule the teachers of algebra have no conception of its use beyond the solution of problems "made up" as illustrations. The real problems which gave rise to algebra, not one teacher in a thousand knows anything about.

Moreover, we give our student workmen facts to reason upon before we set them to formal reasoning. Scientific theories are the product of mature and well-informed minds. There is in recent educational efforts to teach the principles of science, far too much of a certain sort of shallow generalizing on one or two facts, and these more often borrowed or supposed than observed.

Hence, while teaching the use of the chisel and plane and knife, we say scarce a word about the theory of the wedge, and the inclined plane; while giving instruction in the use of the mallet, hammer, and sledge, we say little about momentum and kinetic energy; while teaching the exact and delicate operations of cutting V-threaded and square-threaded bolts and nuts we barely refer to the theory of the screw and to co-efficients of friction. By the time our pupils get far enough in our analytic method of

shop-work, to be able to make an entire steam engine, they are near the end of the course and are familiar with an elementary theory of such engines. Having gained a fair mastery over materials and tools, they are now able to use them in the study of general principles and in the expression of thought.

If this mastery is well gained they have conquered a new world, a world full of thought and valuable experience, a department of knowledge fraught with wide uses and a generous human interest. With it one can never fail to be stronger, clearer, surer in dealing with the problems and duties of real life. In spite of the high authority of the Committee, the mastership of materials, tools, and industrial processes is educative in a high degree. The kind of knowledge acquired is far reaching in its applications and far more invigorating to the mind than the masses of details and circumstances that surround certain literary studies[1] which painfully impress many people competent to judge, as unhappily neither educative nor essential to any rational theory. Mr. Harris once said that a child trained for one year in a kindergarten would acquire a skilful use of his hands and a habit of accurate measurement of the eye which would be his possession for life. How can I adequately express the value of the rich and varied possessions gained by a boy in his teens, having a daily exercise of from one to two hours for three or four school-years in a good series of school-shops!

[1] Such as "memorizing the etymological trash from the lumber room of antiquity."—*Report of Supt. Wm. T. Harris.*

From this brief and imperfect sketch (for I have touched only upon a very few of the details of the manual branches taught in every good manual training school) it must be seen that there is no occasion for making comparisons, disparaging or otherwise, between the study of science pure or applied, and manual training. The two must go on side by side, and instead of trying to belittle one at the expense of the other we should aim to perfect both. This latter aim we greatly help by combining the two. No science teaching without shop-work can possibly be as efficient as it easily becomes with it; and again, no shop-work carried on in a school where no science is taught can possibly be as luminous with thought, as where the two are carefully taught side by side. They are strong allies, and incidentally they serve each other continually.

Thus do I answer the argument of the Report based on a comparison of the study of science with an assumed unscientific construction of individual machines; and thus do I show that while the Committee reasons badly on its own ground, its ground is not at all our ground, and that their argument is entirely irrelevant.

Dr. Harris, in his Ohio paper on the relation of high schools to colleges, says that while a knowledge of natural science, modern literature, and universal history was not demanded nor expected from an educated man one hundred years ago, things are now so changed that no man can pass for educated without more or less minute acquaintance with them. They

have become recognized as "conventionalities of intelligence."

To that statement, which I accept, I would add that a more or less complete mastery of the materials, tools, and processes which underlie the vast industrial developments of this age of scientific applications is fast becoming one of the "conventionalities of intelligence." It will no longer satisfy nor suffice to claim that a knowledge of the details of good workmanship, of the practical arts which underlie manual skill in whatever field of industry, has neither dignity nor educational worth. No Council Committee can be allowed to disposed of it as "a mass of non-essential circumstances."

If the Committee really wish to inquire into the educative effect of our shop-work let them examine it carefully in view of its primary object as I have stated it above, and then see whether the mastery sought is generally worth gaining; whether there is a more efficient method of gaining it; whether our pupils really achieve it; and what its real educational influence is.

VI. *Intellectual powers, mischievous, beneficial and otherwise.* I come now to a most remarkable sample of argumentation.

The Report says:—

"Your committee would here call attention to other arguments often used which are weak and misleading; such, for example, as the statement that manual training cultivates the powers of attention, perseverance, and industry. These are formal powers and not substantial; that is to say, they derive their value from what they are applied to, and they may be

mischievous as well as beneficial. The power of attention may be cultivated by the game of chess, or the game of whist, or of draw poker, or to [*sic*] the picking of pockets; but it is only attention to those subjects, and not attention in general that is cultivated."

In a similar vein, reference is made to games of

"marbles, quoits, base-ball and jack-straws. These too are educative, as manual training is, in the powers named; and they carry with them some general training." "But it would not be fair to expect that these qualities of mind would show themselves in the boys' work in mathematics or history."

It must not be supposed that there is any argument in the above, and I do not suppose that any member of the Committee would claim that there is. The fact that a game is or is not educative does not prove that grammar and wood-turning are or are not educative. Nevertheless, there appears to be an attempt to belittle manual training by coupling it with games. The suggestion of a "mischievous power of attention" is certainly an original one; but the subsequent illustrations of gamblers, pick-pockets, and dynamiters, are scarcely graceful or in good taste. If they have any force at all in the discussion, it is to the effect that the influence of manual training in cultivating attention, perseverance, industry, dexterity, and accuracy may not only be not good, but positively bad.

But the propriety of calling the powers of attention, perseverance, and industry, "beneficial powers" or "mischievous powers," I most seriously question. One may be *attentive* to things good or evil; one may

persevere in right-doing or in wrong-doing; one may be *industrious* in useful or harmful work; but that a committee of four eminent psychologists should soberly assert that these intellectual *powers* can be good or bad, beneficial or mischievous, is passing strange!

A little later in the Report the Committee appear to lament the unwillingness of manual training people to insist upon the repetition of exercises in shop-work till all interest is gone, and till the work excites disgust; because, by such refusal an educative opportunity is lost; "for the patience and perseverance that pursues its work to the end, and bravely keeps down any tendencies to disgust at the lack of novelty, is a moral education indispensable to success in any manual calling."

Are not the powers (or habits) of patience and perseverance just as "formal" and non-"substantial" as ever? and are the Committee sure that here they are beneficial and not mischievous? May not a pick-pocket be patient? and a dynamiter be persevering?

Moreover, when can one know that he is cultivating "attention in general"? Whenever one gives attention to anything it is always to something in particular, not something in general. The committee twice mention approvingly the study of grammar. Perhaps grammar is sufficiently something in general and nothing in particular to be capable of cultivating "attention in general."

Again, is it not just possible that there may be something "mischievous" in the power of attention to certain book-learning, as shown by the tendency

of bookish people to dislike manual labour, and sometimes even to become bad citizens—not to mention dynamiters?

One more word in regard to the educative opportunity lost by not requiring pupils to overcome the tendency to disgust at lack of novelty. The Report says:—

> "No teaching in the studies of the school as they are would be esteemed of a high order if it did not train its pupils to attack difficult studies and courageously overcome them. Mere natural disinclination and impatience must be conquered before the child can become a rational being."

Now the two cases are in no wise parallel. When pupils feel a repugnance to attack difficult studies we urge them to persist, for we know that there is something there which will reward effort. When success does come there is plenty of novelty, and the "habit of doing" is strengthened by the result, which is the mastery of a difficult study.

But when one repeats many times an exercise from which all educative juice has been extracted, he has nothing to reward his effort. The longer he works the less he gets, and disgust is not only natural but highly proper. No amount of trying can overcome it, and the longer one is kept at it the more intense the disgust, unless, perchance, he falls into that unhappy, stupid condition in which one is willing to repeat indefinitely a senseless and fruitless operation.

"Natural disinclination" to do useless things is to be respected, and should never be conquered. Laziness, physical and mental, should be conquered, and

the love of study, whether with book, tool, or apparatus, should be stimulated by a reasonable hope of something to recompense earnest effort. Legitimate manual work is not without its opportunities for promoting industry and encouraging hard work, but the repetition of empty exercises is not one of them.

It may, perhaps, be replied to this that students of the school may become actual mechanics or routine workers in after life, and that as such they will be obliged to repeat many processes from which all lively interest will long since have disappeared, yet they must keep on, with or without disgust.

To this it should at once be answered that the all-sufficient motive then will be, not novelty, not ideas and principles, but wages. Every stroke of work will then mean money, and every repetition will mean more money. Attention will be shifted to a new object which has perpetual interest. No such pecuniary interest comes into school work.

Dr. S. H. Peabody, of Illinois, endeavoured to reinforce the argument of the Report in his paper read at Nashville the day after the Report was made. He said, after referring to the passage quoted above :—

"Accuracy, for example, is of first importance, and no tool-work that fails to show it in a reasonable and constantly refining degree ought for an instant to be tolerated. But accuracy, nakedly and without relationship, has no ethical quality. Accuracy and truth are not synonyms. *Accuracy is good or evil according to its purpose.* Accuracy in fitting a jimmy, that may be used for house-breaking, means burglary. Accurate pistol practice, on the night before a duel, means murder. In like manner, industry is good or evil according to its relationship."

Is there not something chaotic in all that? He declares that accuracy is of first importance, nothing short of it should be for an instant tolerated. So say we, and we claim that manual work is peculiarly favourable to the acquisition of habits of accuracy and industry. Whereupon he wheels square round and declares that there is nothing ethical in naked accuracy. Accuracy and industry may both be evil. Accuracy may mean burglary or murder!

I hope we may not claim too much for manual training. I do not wish to say that there is in it anything which on fair trial will not be found there. It is *not* a panacea for all evils, social, domestic, or personal. It has no monopoly of educational values. It has not even a corner on good habits. It is a valuable educational feature, and should stand beside other valuable educational features, and be judged, as they are, by its fruits. I protest that there is no just excuse for dragging into this discussion burglars, murderers, and dynamiters, as though they in some way furnished arguments against manual training. As to the ethical quality of "accuracy without relationship," I think I shall decline to agree. A single remark must however suffice. When a boy has actually acquired habits of accuracy, attention, perseverance, and industry, in a manual training school or in any other good school, his naked chance of becoming a burglar, a murderer, or a dynamiter is diminished fully 95 per cent.

One is led to ask if the Committee ever thought of applying their method of reasoning to other branches

than manual training. Let them try arithmetic, for example. The Report quotes M. Sluys to the effect "that when the child is compelled to manufacture large numbers of a given object in order to acquire skill in the work, the educative value of the work diminishes. 'From the third or fourth sample his interest wanes; mechanical repetition invariably excites disgust for the work.'"

The failure of manual training schools to force pupils on to the point of disgust constitutes the "opportunity lost." Now, suppose we apply the same reasoning, thus:—

When the child is compelled to perform large numbers of examples in Long Division in order to acquire skill in the work, the educative value of the work diminishes. From the third or fourth page of such examples his interest wanes; mechanical repetition invariably excites disgust in the work.

Keep that work up for fifty or sixty solid pages, with a view to acquiring the skill of a lightning calculator, and there will be "disgust" enough for an entire moral education.

This attempt to make a point against the method of manual training on account of the "opportunity lost" seems to involve the Committee in some confusion. In order to give validity to another argument it was necessary to assume that the shop-work was "trade work," with endless repetitions, until freedom of action was lost in muscular stiffness and insensibility.

The Committee declare that it is a fact that such

repetitions are "deadening to the mind."—But "the advocates of manual training admit" this fact, and consequently avoid such repetitions as contrary to the theory of the school. They steer wide of trade methods and trade work.—"This, of course," the Report says, "makes against the economical argument," but it must not be allowed to stand in favour of the methods of the manual training schools as they exist; so the Committee brings in this argument of an "educative opportunity lost." One is reminded of the children in the market-place.[1]

VII. *The economic value of the method of manual training.* Does the method of the manual training school "make against the economic argument" in behalf of such schools?

The Report says:—

> "The advocates of manual training admit that it is useful as education only if not carried to the point of arriving at skill in production. This feature, of course, makes against the economical argument in behalf of such schools. According to the economic view, skill in production is the primary object aimed at by introducing the training of the hand into schools."

I could well afford to pass this attempt to array against manual training those who advocate trade instruction, and trade schools. I do not know how many of such men there are among us. I have never met ten in my whole experience, and those I have met were outside the schools and confessedly unfamiliar with the details of either trades or

[1] *Vide* Matt. xi. 16–19.

schools. Nevertheless, I should be sorry to have any one misled by such an argument. I shall therefore try to show that the refusal on the part of the teacher of manual training to adopt "factory" methods, and insist upon repetitions until motions become semi-automatic, requiring little or no conscious mental activity, does *not* "make against the economic argument."

The highest economy in all arts and all industries is that which most employs brains. If there be any art or industry which is not more remunerative the more one brings to it intellectual training of a healthy sort, let us boycott it. One's value in whatever manly occupation is in proportion to his intelligence, his potential energy (to borrow a term from mechanics); and that energy depends upon the amount of intellectual power at his command. What we call *skill* in executive work depends upon speed, order, and accuracy. When the mind has mastered the conditions of order and accuracy, the major part of skill has been achieved.[1] Speed comes with practice, in which there is scarcely a new idea. Again, if, the moment one has grasped the conditions of order and accuracy as related to the material to be wrought, the tools to be used, and the forms to be produced,—he sets out by numerous repetitions to acquire the element of speed which shall combine with the former to produce skill, he loses numerous opportunities to acquire an intelligent

[1] Bacon said that what he had been able to accomplish was due to "order and method."

mastery of other materials, processes, and conditions. The student who stops to acquire complete skill, narrows his training and shuts himself out of the range of free activity. The lack of true economy in such a course seems plain. Hence, while a manual training school aims not at complete skill in individual operations, it does aim at the intellectual part of all operations. I am as certain as I can be of anything not actually tested by experience, that the manual training school would have far less economic value if it should cease to make intellectual training its chief object, and set about producing skilful factory hands and producing articles for the market.

Let no one be surprised that I speak thus of intellectual training; that I set it forward as the pre-eminent object of a manual training school. There is no royal road to intellectual power. Perception, memory, imagination, and judgment may be cultivated in a thousand ways. When one sets out to select the best means for training the intellect and the will he is embarrassed by the great variety of available appliances. Generally, extraneous considerations determine his choice. He is governed largely by convenience and the incidental value of what the mind stores up and exercises itself upon. It would be very easy to show that convenience, availability, use, conventionality, and fashion have largely shaped the traditional course of study. By fashion I include an active tendency away from utilitarian ends to such a degree that the purely intellectual value of a study is held to increase as

its practical value decreases. In other words, it is the fashion to assume that, if a study has no economic value, its intellectual value must be not only pure but great. This doctrine must be admitted as partly true. If a study has no economic value, its value must be purely intellectual, whatever that may be—there is no denying that conclusion; but it does not at all follow that because its value is wholly intellectual, it is therefore greater than the intellectual value of another study, which is at the same time very useful. Herein lies a very weak point in the position of those who oppose the introduction of manual training on what they call educational grounds. They talk loudly about intellectual studies,[1] and stoutly maintain their superiority to mere manual exercises which have only low and sordid ends.

If they are "*mere*" manual exercises, such a statement is of course sound, and is trite enough, but when these opponents go on to draw conclusions from it adverse to manual training, their error is twofold. First, they ignore the fact that manual *studies* are intellectual as well as manual; and, secondly, they fail to take account of the fact that the intellectual elements involved in them are for the most part of a very superior character, admirably suited to stimulate and invigorate the mental faculties.

I am anxious not to misrepresent those who fail to

[1] The Report uses the word "spiritual" and "spiritual education" repeatedly, as if the word furnished a stronger contrast with the "gross materialism" of manual training.

agree with us. They honestly believe that it injures the educative influence of a study to have a clear and decided practical bearing. They have often claimed that its tendency is to corrupt the mind; to withdraw the attention and interest from purely intellectual ends; to lower the moral tone. If improperly taught, it may be so, as one may study pedagogics from sordid motives, and hence we cannot take too great pains to secure a quality and manner of teaching which is of the highest grade. Nothing is more fatal and disappointing than ignorant and ill-trained teachers.

But with competent and thoroughly trained teachers the supposed demoralizing influence of the practical side of a study does not occur. The question of what is moral, what intellectual, and what practical in a study does not rise particularly in the minds of pupils. Every study should bear in all three directions. No sensible teacher ever says to his pupils (what no one should ever be *able* to say), "This study has no practical value, but it is highly intellectual." On the contrary, every good teacher aims to impress his pupils with the immense probable and possible practical value of a complete mastery of the subject in hand. The best intellectual culture is gained unconsciously, when the student is so absorbed in his work that he takes no thought of its effect upon himself. On the other hand, how absolutely unhealthy is the effect, both morally and intellectually, of a study, a book, or an exercise which a student hates and shirks, and is glad to lay aside for ever! The traditional cur-

riculum for secondary schools has been so pruned and trimmed in order that the economic may be at a minimum, and the purely intellectual (*i.e.*, the practically useless) may be at a maximum, that the pupils who are keenly alive to the necessity of practical training, and parents who feel as Supt. Sabin of Iowa puts it, that only "applied (appliable) knowledge is power," see little beyond the three R's which to the average youth is worth the getting.

Paradoxical as it may seem to many, manual training was organized and is carried on in the interest of a better and more rational intellectual training. It aims alike and at the same time to intellectual culture, to moral worth, and at practical power and efficiency.

VIII. *The argument against liberal culture in tool-work.* The last argument against manual training urged by the Report is a purely economic one and very wide of the mark at that; and hence might well be overlooked, but it has appeared so frequently and so persistently—it appeared three times at Nashville in three different papers—that it may be well to attempt to dispose of it now for good. The Report says:—

"The education of the muscles of the hand and arm, the training of the eye in accuracy, go for something in the way of education, especially if these, too, are of a general character, and productive of skill in many arts. But it happens in most cases that the training of the muscles for a special operation unfits it more or less for the other special operations. Every trade has its special knack or skill, and not only requires special education to fit the labourer to pursue it, but it reacts on him,

and fixes in his bodily organism certain limitations which for greater or less extent unfit him for other occupations. The work of blacksmithing, for instance, would unfit one for engraving; the work in planing and sawing would diminish the skill of the wood-carver. Work in the trades that deal with wood and metals (and these include the entire curriculum of the manual training school) would be disadvantageous to the delicate touch required by the labourer on textile manufactures; and this class of labourers is nearly as large as the combined classes of wood and metal-workers."

In the discussion which followed the reading of the Report, Dr. Harris explained that by the "delicate touch required by the labourer on textile manufactures," he meant such things as "picking up threads and tying knots."

So many ideas struggle for expression in commenting on that paragraph that I scarcely know where to begin. It must be perfectly transparent to all that the writer could not have been thinking much of the work actually done in manual training schools. He was thinking of trades and trade-work all the time, calculating the number of wood-workers, metal-workers and textile-workers in the United States, and supposing that the mastery of one trade unfits for another.

Unless manual training is trade training, the passage has no force in the Report. On no purely educational theory does the number of labourers in a certain class, as shown by the census, have claim to consideration. As the manual training school is *not* a trade school, either in theory or practice, I might dismiss the matter as irrelevant, but were I to do so, I might

appear to admit that the economic value of tool-training, even when carried to a point far short of the demands of a trade, was diminished by giving it breadth and liberality.

Now we do not doubt that a fair proportion of our students will become mechanics. Students from high schools which do not have manual training become mechanics and why should not ours? All of our students have high respect for mechanical skill; without exception they all enjoy shop-work; and the demand for our students from manufacturers is very great. What wonder, then if many find it for their interest to accept positions as tool-users?

Let me warn the reader not be misled by shallow reasoning on this point. If one does not become or remain a mechanic it does not prove that he dislikes manual work; it only suggests that he has found some other occupation more remunerative. On the other hand it does not follow that because one does become a mechanic he is therefore in love with manual labour. People are often forced to perform labour which they dislike. Examples have not been wanting in recent educational literature, in which writers have reasoned very weakly on these points.

Returning now to our examination of the passage from the Report, in spite of its extravagant trade bias, and an insinuation that our training is too narrow, we find a distinct argument that it is too broad. The argument as it applies to us stands as follow: Long practice in special narrow operations results in certain muscular habits which seriously interfere with one's

free activity when he would undertake different operations. What is true for long practice is proportionately true for short practice; hence, what one acquires at the forge unfits him for the joiner's bench, and conversely; an exercise which hardens one's hands disqualifies for an exercise requiring soft and flexible fingers.

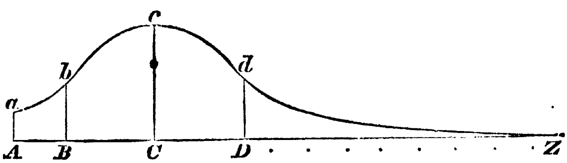
Such appears to be the argument,—purely muscular and physical in character. I do not understand that there is any claim of mental disqualification,—and yet it seems to me that there ought to be, for it is there that is found the most unfortunate effect of endless repetitions of muscular operations. Stupidity is the fate of Mr. Brown's turner of plough-handles. "Ten hours a day for twenty years has transformed the man into a machine." His work demands no conscious effort of the mind, and hence the mind lies idle while the hands move automatically. It is possible that such a mind may become so blunted and deadened that healthy mental activity is impossible. Such would be the argument of the Report if it consistently made the most of its position.

Now, let us see how these theories—including the one I have added to make them consistent and complete on the supposition of long, unbroken practice—apply to such work as is really under discussion, viz.: the tool-work of the manual training school.

To begin with, the law of simple, direct or inverse proportion does not hold in measuring the intensity of mental activity in the act of repeating a special operation or exercise. A man may become dull and

insensible, mentally and physically, while repeating the same special operation three million times, but it does not follow that he would grow dull and insensible to the one-millionth of the former extent, as the result of repeating the operation three times. If the operation were one requiring skill, with the elements of order, accuracy, and speed, the probability is that the interest and the mental activity would increase gradually to a maximum and then begin to wane. So long as the art was imperfectly understood, so long as it stood as a challenge to one's intelligence, the interest would grow. As soon, however, as the intellectual part of the art was mastered, and nothing remained but the necessity of a more perfect co-ordination of the muscles to produce speed, the interest would rapidly fall away.

This may be clearly represented by a diagram.



Let the line *A B C* . . . *Z* denote the lapse of time required for countless repetitions of a special operation. Let the perpendiculars *Aa Bb Cc* &c., denote the degrees of interest which mark the mental activity during different repetitions. The initial interest *Aa* may be greater or less; if the exercise is well chosen, the interest will increase slowly at first, then rapidly as at *Bb*. The number of repetitions required

I have said that the mental activities were in part identical, and I have shown that so far they are identical a new analogous operation is more easy and proportionally less valuable educationally. But the activities are in part dissimilar, in consequence of new materials and new conditions. Hence a liberal range must be allowed that the judgment may be broadly trained, and that the mind may be led to make critical comparisons. Hence in manual training schools, from Massachusetts to California, and from Minnesota to Louisiana, hammers are used—(I keep in mind the use of hammers as an illustration, partly because the hammer has, so to speak, been so often thrown at us, and partly because it may well be taken as typical of numerous classes of tools)—hammers are used on tiny brads and on huge spikes, in mortising and in wood-carving (*i.e.*, wooden hammers or mallets), on soft and hard iron (hot and cold), on lead and on steel. This is liberal culture, reasonably sufficient both for mental discipline and for rigid economy.

But I am not limited to psychological reasoning in establishing the value of a liberal culture. There is abundant evidence from actual experience that neither in the manual training school nor in the realm of practical mechanics is it found that skill (such as there may be) with one set of tools stands in the way of acquiring skill with different tools.

If I am not mistaken, President Peabody, of the Illinois University, whom I have already quoted, first suggested the argument which appears in the Report.

More explicitly, he asserted that the ability to use correctly the carpenter's hammer is not only of no value in learning to use a machinist's hammer, but that it is a positive hindrance; in other words, that it is more difficult to make a machinist out of a carpenter, or a carpenter out of a machinist, than it is to make a carpenter or a machinist out of a green hand who had never handled a hammer of any sort. Says he, "if the one use of a hammer which the boy has acquired, does not interfere with the use of it in a different way or for a different purpose, then I much doubt whether he has really learned that one use." I suppose Dr. Peabody has a standard of attainment in hammering peculiarly his own, for he goes on to add: "Certain kinds of skill *require that a man stop thinking*, and put himself as nearly as possible in the condition of a machine and carry through a series of movements like a machine." I have no use for men nor for boys who have reached that stage. All persons I meet have abundant and continual use for their brains.

Not long since it became necessary for our teacher of metal work to take a class in joinery and wood-turning. He had learned the machinists' trade and had been at work on iron and steel for ten or fifteen years, and no one presumed to say that he had not "really learned" the use of the metal-working tools. He was a comparative stranger to joinery and knew absolutely nothing about wood-turning. It was astonishing to see how quickly he mastered the new tools. In a dozen lessons he learned more than a

green hand who had never used tools at all would have learned in fifty lessons. So boys who come to our school with some knowledge of iron-work always go to the front in wood work. And boys who enter the school in advance of the regular admission, and who consequently lack the tool training of the earlier year or years, are always at great disadvantage in shop-work, though the operations omitted are quite unlike those they enter upon.

I have made systematic study of this question, with the results as stated. There is not a shop teacher in my school who does not hold that this "unfitting" argument is totally unsound. In my Harvard days I was an oarsman for three years, and I knew well the degree of stiffness and insensibility which the automatism of daily pulling a long oar gives to one's hands. There is nothing in the whole course of tool-work in a manual training school which can be compared with rowing in that regard. Last year two of my graduating students were unusually skilful musicians, one on the piano, the other on the violin. Neither ever complained of stiff fingers, though one of them said the iron work soiled his hands and spoiled his nails. Those, however, were trifling matters which a week's vacation would remove.

Here I submit the arguments. The position of the Report appears to me to be unsound, whether examined *a priori* or *a posteriori*. My conclusion is that knowledge, intelligence, skill, power, and culture are always helpful in the acquisition of more knowledge, more intelligence, more skill, more power, and

more culture. The more accomplished one is, the easier new things are to him, whether in the realm of pure intellect or in the field where mind and hand are cultivated together.

IX. *Conclusion.* The significant report of Supt. Seaver, of Boston, touching the "educative value" of manual training is a timely commentary on this Council Report. He was commissioned to visit the manual training schools of Chicago, Toledo, Cleveland, Baltimore, Philadelphia, and St. Louis, and to make a thorough inspection. His report is so *àpropos* that I venture to give it in an Appendix.

As a companion to the report from the superintendent of the public schools of Boston, I venture to insert an extract from the last report of Superintendent MacAlister, of the public schools of Philadelphia.

He says that while the course in tool-work and drawing are the distinctive features of the manual training school, "it must be borne in mind that the others are not neglected. On account of its novelty the manual training is apt to make the strongest impression upon visitors, and they do not always discover that the literary and scientific training are just as fully recognized and provided for. Anything like a one-sided culture is carefully avoided, the aim of the school being to give to each branch, whether scholastic or manual, such relative importance as shall lead to a fuller and more symmetrical development of

mind and body than has been possible under the old systems of secondary education.

"The success which has attended the manual training school from the first is the best guarantee of the soundness of the principles upon which it is organized and conducted. Beginning a little more than four years ago, in a very humble way, it has steadily grown in public confidence and approval. It has more than justified every claim that was made in its behalf. Every available foot of space is now occupied, and it has now become impossible to admit all the pupils who apply for admission. The Board of Education has therefore been brought face to face with the question whether the time has not come for opening another manual training school in such a quarter of the city as may be deemed most advantageous to the public interests. The original intention of the Board was to establish four or five of these schools as fast as a just regard for the other departments of the school system would permit, and the growing demand for the kind of education which this school represents will render the fulfilment of this purpose a necessity at no very remote date." [1]

Thus the work goes on. The intellectual fruits of a rational, well-proportioned system of manual training are evident to every close observer and student of that training. Far from being a power for mischief, it is a potent instrumentality for good; it is a strong

[1] *Manual Training in the Public Schools of Philadelphia*, by James MacAlister, Superintendent, March, 1890.

and friendly ally in promoting educational progress, and in ameliorating the condition of all classes of the people.

APPENDIX.

APPENDIX.

REPORT OF A VISIT TO MANUAL TRAINING SCHOOLS, ACCOMPANIED BY A DETAILED PLAN FOR A MANUAL TRAINING HIGH SCHOOL IN BOSTON, BY EDWIN P. SEAVER, SUPERINTENDENT OF THE CITY SCHOOLS.

To the Committee on Manual Training.

IN the preparation of the plan given below I have drawn freely upon the experience of other schools, and more especially upon the experience of those I was commissioned to visit and inspect in St. Louis, Chicago, Toledo, Cleveland, Baltimore, and Philadelphia. The results of my observations in these schools are, for the most part, embodied in the plan now submitted. Still, a preliminary description of the schools themselves may be not without interest, and will be useful as throwing light on the details that are to follow.

The St. Louis Manual Training School was organised under the charter of Washington University, in the year 1879. Under the same charter had been organised already two other schools of like grade—one a classical school preparing boys for the University, and one a girls' school pursuing academic studies. The Manual Training School also serves as a preparatory school, sending about three-fifths of its pupils into the polytechnic department of the University, or into similar institutions elsewhere. The other two-fifths of the pupils, however, end their schooling here, and pass at once into active life. The catalogue of graduates shows that most of these latter have chosen pursuits in which their training in the mechanic arts is highly advantageous, if not indispensable.

It is well to remember that this school, as conceived and established ten years ago, was the outcome of efforts that had for some time been making to supply the polytechnic students of the University with a knowledge of the mechanic arts in the only really effective way in which such knowledge can be imparted—that is, through actual shop-work done by the students themselves. In the course of these efforts it was discovered that the use of tools and machinery could be taught to boys of fourteen or fifteen, as well as to the older polytechnic students, and with decidedly satisfactory results. Hence arose the idea of a preparatory school, with its course of study composed of book-work, shop-work, and drawing. Then came a very natural enlargement of this idea, when it was understood that such a preparatory school would also be a useful kind of high school for general purposes. Thus a new type of school was originated, examples of which now exist in a score or more of cities.

The experience of the St. Louis school is the longest among existing schools of its kind, and may possess on that account the greater interest. The school has been decidedly successful from the beginning. The last catalogue shows the names of 241 pupils; or 53 in the graduating class, 83 in the middle class, and 105 in the junior class. Five-sevenths of the pupils resided in St. Louis, and two-sevenths were from other towns in Missouri or from other States. There is a considerable charge for tuition—$75, $100, or $120, according to class; but there are some free scholarships that were established in connection with the permanent endowment of the school. The school building occupies a fine site near the University, and is a neat, substantial structure of brick, containing three school-rooms (one for each class in the school), two drawing-rooms, and four shops. The plan of this building is good; but experience has suggested improvements, which have been realised elsewhere.

At the time of my visit the school was in full operation. The director, Professor Woodward—who is a professor in the engineering department of Washington University, and exercises only a supervisory function in the Manual Training School—bade me make myself perfectly at home, question the teachers, question the boys, and make my investigation as

thorough as was in my power with all the help they could give. I devoted four days to the investigation. The results were a large book full of notes, and a clear impression in my mind of a well-organised and vigorously working school. I cannot here go into details. Suffice it to say, I used my privilege of questioning freely and thoroughly. I followed classes from the school-rooms into the drawing-rooms, and into the shops. I found the boys equally alert and intelligent in all branches of their work. They were as ready to describe and give the reasons for every step in the process of forging a pair of blacksmith's tongs as they were to state and give the reasons for every step in the demonstration of a geometrical theorem. There are those who doubt the "educative value" of manual training. Let any such person spend a few hours in a good manual training school like this, observing the boys at their work and questioning them about it; and if his doubts about the "educative value" of manual training do not vanish, it will be because he measures "educative value" by standards not in common use. I should desire him particularly to converse with those boys in the machine-shop, now drawing near the close of their school course, and busily at work on their "projects" for graduation day. Let him ask for explanations, question them closely for reasons, observe the quality of their work, note their own criticisms and estimates of it, and he must be an unreasonable man if he does not admit that somehow their school training has developed in them a high degree of intelligence. The result is too striking to be overlooked, analyse and account for it as we may.

The Chicago Manual Training School resembles the St. Louis school in most particulars; but not being related as a preparatory school to a higher institution, it has embodied more distinctly the other idea, that of a high school for general purposes. . . . The school is carried on by the Chicago Manual Training Association, a corporation created by the legislature of Illinois; and the object of the school is thus stated in the Articles of Incorporation:—

"Instruction and practice in the use of tools, with such instruction as may be deemed necessary in mathematics, drawing, and the English branches of a high school course. The tool instruction as at present contemplated shall include carpentry, wood-turning, pattern-making, iron chipping and

filing, forge work, brazing and soldering, the use of machine-shop tools, and such other instruction of a similar character as may be deemed advisable to add to the foregoing from time to time, it being the intention to divide the working hours of the students as nearly as possible equally between manual and mental exercises."

Boys must be at least fourteen years of age, and prove themselves by examination to be well versed in the studies of the ordinary grammar school course. There is a charge for tuition of $80, $100, or $120 per year, according to the class a pupil belongs to. The last catalogue shows 229 pupils,[1] mostly residents of Chicago. About two-fifths of the graduates enter higher institutions of learning, and three-fifths go into active life.

The manual training schools at Toledo and at Cleveland are unlike those already described; for they are not complete and independent schools, but are annexed to the public high schools in those cities. They are supported, however, by private endowments, not by public funds. The tuition is free, except a slight charge for material, loss, and breakage. The management is by trustees acting in co-operation with the public school boards. The buildings are, in one case, attached to, and in the other quite a distance away from, the high school-house. They contain only shops and drawing-rooms. These shops, in both schools, are decidedly superior to any I have ever seen elsewhere; but if a choice were to be made between the two for a model to follow in planning and furnishing new shops and drawing-rooms, my preference would be given to Cleveland.

The formal opening of the Toledo Manual Training School in the new wing of the high school building took place in December 1885. The work in the mechanic arts and in drawing for the boys is substantially like that in St. Louis and Chicago schools. But this Toledo school is open to the girls as well as to the boys, and domestic economy—that is, sewing, cooking, and dressmaking—holds a place by the side of the mechanic arts in the course of study. The girls share with the boys the instruction in drawing, wood-carving, and light joinery.

[1] Additional room is being furnished, and the school will be much larger next year. The number of applicants, both in St. Louis and Chicago, greatly exceeds the capacity of the schools.—C. M. W.

This girls' department may serve as a suggestion by-and-by to us here in Boston.

The Toledo school is open to boys and girls, not only from the three classes of the high school, but from the "senior grammar" class as well. This makes the course in manual training four years long, covering the eighth, ninth, tenth, and eleventh years of schooling. As already stated, the boys and girls who take this course take it as a clear addition to their other school-work, they being obliged to learn by home study lessons which their class-mates not taking manual training have the time to study in school. But there have been no complaints of overwork, no falling off in interest on the part of the pupils who have once chosen manual training. On the contrary, manual training appears to be so attractive to the pupils, or to their parents, that the tendency to drop out of school before the end of the course has been in late years decidedly checked. The number of pupils in the Toledo High School has doubled within the last few years; and a large share of this increase, the teachers say, is clearly due to the introduction of manual training.

It is worth mentioning that the labour unions made hostile demonstrations towards this school soon after the introduction of manual training; but a large delegation of their members made an all-day visit to the school and went away favourably impressed, as they said, and subsequently all opposition was withdrawn.

The Cleveland Manual Training School originated in a small carpentry class, started in February 1885 by Mr. Newton M. Anderson, then a teacher of physics in the Cleveland High School, for the benefit of some of his high school boys. The time taken was out of school hours, and the place was a barn. "Through the diligence and enthusiasm of these boys, this little school, and the value of manual training, was brought to the notice of some of the business men of the city. One or two meetings were held, at which the question of the establishment of a manual training school in Cleveland was thoroughly discussed. It was decided to form a stock company with a capital of $25,000, with which money to erect and equip a building, and then to charge a tuition fee just sufficient to cover running expenses." The new building was opened for the school in February 1886. The tuition is free to all pupils of the

Cleveland public schools (except a small charge for materials); to all others, $30 a year. There were 179 pupils at the time of my visit.[1]

The course in this school is three years long, but the experiment of a post-graduate course of one year has been made with two pupils. The work of each of these two pupils was to be the construction of a three horse-power steam engine. "The result of the experiment," says the principal, in a recent report, "has been very satisfactory in many ways, as it has been shown that pupils can apply what they learn, that they are interested in their work, and that they work much more rapidly than would be supposed by judging from their former work, when some difficulty had to be overcome at every step. Both of the engines will be running by the end of the term."

The same report contains this statement: "At the request of the pupils, the school was open, and the instructors in their places, every day during the Christmas vacation, while the attendance was about fifty pupils per day." Such requests to be allowed to work in the shops extra time have been granted to pupils in the St. Louis and Toledo schools; but in Chicago such requests, though occasionally made, have always been denied. When pupils petition their teachers for instruction out of school hours and during the holidays, we may be sure the instruction is uncommonly interesting.

The Baltimore and the Philadelphia Manual Training Schools resemble those in St. Louis and Chicago in being complete and independent schools, with a course of study occupying the pupils' whole time; but they differ from all the schools hitherto spoken of, in that they are purely public schools, receiving no support whatever from any source other than the city taxes. The Baltimore school started in 1884, and the Philadelphia school in the following year. Both are large schools, being very inadequately accommodated in the old grammar school buildings which they occupy; and both have proved so popular that new or enlarged buildings are soon to be provided. There were 394 names on the Baltimore catalogue, and 326 names on that of Philadelphia. The Philadelphia boys must have finished the grammar school course before they can be admitted to the manual training school—a requirement which makes that school

[1] Efforts are now making to establish and endow a large independent manual training school in Cleveland.

a true high school in its relations with other parts of the public school system. At St. Louis, Chicago, and Cleveland the requirements are practically the same. At Baltimore boys from the two upper grammar grades are admitted to the manual training school, which is a step beyond the practice at Toledo. In the tinsmith's shop at Baltimore there were observed a number of boys under twelve years of age. The work they were engaged in was light work. Experience here, at Toledo, and elsewhere has shown that city-bred boys under the age of fourteen seldom undertake the regular shop instruction in mechanic arts with satisfactory results. If such boys are admitted, lighter kinds of work must be provided for them.

The course of shop instruction at Baltimore, aside from the tinsmith's work just mentioned, is much like that of the other schools; but there is an observable tendency towards the practical, as opposed to the æsthetic, side of the work. This is shown in one way by the comparatively larger number of completed and useful articles to be found among the products of the boys' shop-work.

The Baltimore school, almost from the beginning, has been in charge of an officer of the United States Navy, Past-Assistant Engineer John D. Ford, who has been detailed from time to time by the department for this special duty. The school undoubtedly owes much of its success to the vigour and skill that have been exercised in the management, not only of its internal affairs, but particularly of its external relations with the municipal authorities and the public at large.

The Philadelphia school has a course of shop-work that is distinguished from others by two prominent features. The first is the distinct emphasis placed on the æsthetic side of the work. Free-hand drawing, clay-modelling, and wood-carving are all co-ordinated with, and intimately related to, the successive stages of the shop-work. The ornamental work in wrought iron is worthy of special praise, not so much in point of workmanship, though that is good, but particularly because of the systematic art instruction it illustrates. The second prominent feature appears in the arrangement of shop-work. A part of the iron-work is placed in the first year parallel to the joinery. The exercises are so arranged in many cases that the same idea may be worked out first in soft material (cutting wood), and then in hard material (chipping and filing iron); or again, by shaping

from the outside soft material (clay), and then harder material (lead or hot iron). This apparently logical arrangement is quite attractive.[1] The same idea I found quite well carried out in the School of Manual Training in Girard College, which I visited for the second time while in Philadelphia.

A PLAN FOR A MANUAL TRAINING HIGH SCHOOL.

The grade of the proposed school and its relations to existing public schools are best marked by naming it a *high* school, while the words *mechanic arts* indicate the characteristic feature of its course of study. The curriculum of this school, like that of the other high schools, should begin when that of the grammar school ends. It should be three years long. The requirements for admission should be a grammar school diploma or the equivalent examination, age not less than thirteen, and a good character.

Before speaking of the shop-work in detail, it may be well to dispose of the other branches of the school-work in a few words.

The book-work should be in English language, in mathematics, and in science; but a part or the whole of the science could be replaced by a foreign language if circumstances made it desirable for any considerable number of boys to make such a substitution. This might well be the case with boys preparing to enter some higher institution of learning.

In English language the chief effort should be in the direction of training to clear and correct use of language in both oral and written expression. Literature and history would not be directly the subjects of study in this department, but they would supply the material to be worked upon; and thus incidentally the pupils would become acquainted with a few works of the great writers.

[1] It is doubtful if this mingling of wood-work with iron-work gives good results, and the general opinion of manual training teachers is strongly against it. The analogy between the two kinds of work is merely nominal. Planing wood and planing iron are really as unlike as two processes can well be.—C. M. W.

The mathematics should include elementary algebra, plane and solid geometry, descriptive geometry, and plane trigonometry. A thorough acquaintance with these branches has been found essential to the best success, both in drawing and in mechanical construction.

The science should be physics and chemistry. The method of teaching both these branches should be that known as the laboratory method. If circumstances make this method impracticable—as is the case now in some high schools—the time would be better spent in the study of a foreign language. The day for mere book-work and lecture-notes in science has gone by. Some of the apparatus used in the laboratories may be made in the shops by the boys; but not all. There is an important limit to be observed in this matter. Boys should not be set to making their own chemical or physical apparatus unless the knowledge to be gained from such making be at least as valuable as the knowledge to be gained from any other kind of shop-work that could fill the same time. To set boys to make things for no other reason than to save money in the running expenses of the school is wrong; for it is to sacrifice the boys to the school, whereas the school exists only for the benefit of the boys.

The drawing should be carried on with constant reference to the shop-work, which it is designed to assist, and from which in turn it will receive assistance. As educational agencies, drawing and construction belong together as two parts of one whole. Neither is fully efficacious without the other. Like the two blades of a pair of scissors, each requires the aid of the other to do its own work. The drawing teacher will therefore keep the shop-work constantly in view, co-operating with it, and using it as the chief source from which to take illustrations. The shop teacher, on his side, will see that every piece of work, however simple, be executed from drawings made by the pupil. Thus the whole work of the drawing-rooms and shops becomes one course of practice in the expression of ideas, through drawing and construction. The drawing will be chiefly of the kind known as mechanical drawing; but the æsthetic side of the work should be provided for by adding a reasonable amount of free-hand drawing.

The shop-work will be described first in outline, and then in more detail.

The first year's shop-work should consist of carpentry[1] and wood-turning chiefly; but for the æsthetic side of the work there should also be a considerable number of lessons in wood-carving. The year's work should be drawn up in a fully detailed series of lessons or exercises, which should be required of all pupils alike, the whole class beginning each new exercise in the series simultaneously. Then there should be drawn up a parallel series of supplementary exercises, to be given, as occasion may require, to those quicker pupils who complete the regular exercises in less than the allowed time.

In the work-shop of the second year the wood-work is continued and becomes pattern-making. This is accompanied and followed by a brief course in moulding and casting. The material used for casting may be either plaster or soft metal. The latter is easily managed, and may be melted over and over again, thus avoiding waste. The same may be said of brass. Although there appears to have been little experience with the casting and finishing of brass thus far in the schools, there is good reason for believing that experiments in this direction would prove very satisfactory.

Iron cannot advantageously be used, for it would necessitate the expense and the trouble of a cupola. Besides, the process of iron-casting, to be of much educational value, would involve more knowledge of metallurgy than could well be contemplated in a school of the character now proposed.

Whatever iron castings might be needed for the third year's work could best be procured at a commercial foundry in the usual way; that is to say, the boys would make the patterns of the castings they needed, send them to the foundry, and receive the castings in due time. It would doubtless be found practicable occasionally to arrange a visit to the foundry by a class when castings were to be made from their patterns, or at other times.

After the pattern-making, moulding, and casting, which, altogether should occupy twelve or thirteen weeks in the early part of the second year, should come the forging, which will occupy the remaining two-thirds of the year. The forging begins with simple exercises in bending, drawing-out, and upsetting; then follows welding, with exercises of increasing difficulty, requiring more and more knowledge and skill; and

[1] The word "joinery" is much preferred to "carpentry."—C. M. W.

the course concludes with each boy's forging and tempering a set of tools which he will use next year in the machine-shop.

Supplementary exercises in forging should be provided for the quicker boys. There is an endless variety of ornamental wrought-iron work that may be suggested for supplementary exercises, although some ornamental work should have a place in the required exercises. Thus the æsthetic side of the work would receive due attention. Ornamental wrought-iron work is now so much in vogue that the boys would find it very interesting, both in designing and in working out their designs. Their designs should first be made on paper and submitted to the teacher for criticism.

Not until the designs have been approved does work at the forge begin. By this double process of making designs and working them out in material is the great lesson learned that mere prettiness, or beauty even, in a design is not necessarily an element of value. If a design be unworkable in the material intended, it is worthless.

The shop-work of the third year should be almost wholly in the machine-shop, consisting of exercises in chipping and filing and of exercises at the machines.

After the prescribed exercises of the year have been done, each pupil should be ready to undertake, either alone or in partnership with one or more other pupils, some project, or complete piece of mechanical work, which may serve as the crowning exercise of the whole instruction in mechanic arts. These projects correspond to the graduation theses of academic courses of study.

A project is begun in the drawing-room, where the plans and shop-drawings are prepared from given specifications. Then the patterns are made in the wood-working shops. The iron castings are best obtained at a commercial foundry, for reasons already explained. The pupils take the castings to the machine-shop, where they do the fitting and finishing, and where the whole project is put together and tested. In this way the boys, in their third year, are taken over the whole ground of their previous instruction in mechanic arts, and their knowledge is unified and solidified. The projects usually undertaken by two or more boys in partnership are steam engines, dynamos, speed-lathes, steam-pumps, and other such machines. Some of the schools now possess machines

thus constructed by pupils which have been doing good work for some years. At Baltimore is a steam engine, made by the pupils of the school, which furnishes all the power used in the shops. At Chicago is a smaller engine, made in the school by pupils, which is used for driving some of the machinery of the shops. In the Naval School at Annapolis, where instruction in the mechanic arts is given to the cadets, there are good steam engines of various patterns, all the work of past graduating classes. At Cleveland is a 40-light dynamo, made by the boys, which will be used to light the machine-shop.

Machines like these are undertaken only by several boys working together; for single boys the projects must be simpler and less time-consuming. As has been stated already, the boys' work on these projects begins with the preparation of drawings from *given* specifications. To originate designs of machinery, or to make specifications in accordance with scientific principles, would be too high a task for the boys to undertake at this stage of advancement. They must therefore take the designs and specifications of their projects from their teacher, or from some other competent authority. These having been obtained, all the rest of the work, save the casting, is the boys' own work, done under the general advice and guidance of the teachers.

Projects are not necessarily confined to the third year. They may be advantageously introduced near the end of the carpentry course in the first year, or near the end of the whole wood-working course in the second year, or near the end of the forging course in the same year. These would be especially desirable for those boys who had finished the prescribed exercises in an excellent manner and in less than the allowed time. Boys of this sort there will always be; and the highest success of the school will depend on keeping such boys interested and busy. Pieces in cabinet-making, ornamented with wood-carving, and pieces in ornamental wrought-iron work would be quite within the boys' power to execute satisfactorily; and such pieces would serve well, not only to display acquired skill in workmanship, but also to bring into play the artistic feeling. As to the material used in any of the projects, if its cost should be worth considering, the boys should be expected to provide it or pay for it, in case they desire to possess the completed article. All projects, however,

should be held by the school so long as they may be needed for exhibition.

Such in outline is the shop-work which experience has shown to be practicable and useful, resulting in a good degree of general mechanical skill and a high degree of mechanical intelligence. The main features of this shop-work course may be regarded as permanent, although the details may be expected to change from year to year as taste or convenience may suggest. Nevertheless, at the outset the proposed school will need a fully detailed course of shop-work, showing all the particular exercises, both required and supplementary, together with suggestions of suitable projects for the end of the whole course and of other periods; and such a detailed course would be presented here in this report, with woodcuts to illustrate it, were it not, fortunately, so easy to refer to a recently published book[1] containing all the needed descriptions and illustrations. The exercises in carpentry, wood-turning, pattern-making, wood-carving, forging, chipping, filing, shaping, and finishing, fully described and pictured in this book, as executed in the St. Louis Manual Training School, leave little to be desired; and these may be adopted with all the more confidence since the other schools have adopted substantially the same. For exercises in moulding and casting, reference may be made to the courses of some other schools, especially to that of the Massachusetts Institute of Technology. Also there are good examples of ornamental wrought-iron work to be taken from the schools at Chicago and Philadelphia. From these sources of information is derived the following brief statement of the contents of the various courses of shop-work that should have place in the proposed school:—

(1) Exercises in carpentry. Rip and cross-cut sawing. Pieces of rough stock sawed out to given dimensions. Planing pieces of board to given width and thickness—true faces, straight and square edges. Squaring the ends of pieces. Nailing pieces together to form a box. Making a mitre-box. Testing the mitre-box by cutting four pieces for a square frame with mitre-joints. Making a picture-frame from a piece of moulding—mitre-joints. Paring with a chisel (*a*) the end of a square piece in the form of a square pyramid, (*b*) the other end in the

[1] *The Manual Training School*, by C. M. Woodward. Boston, 1887.

form of a semi-cylinder, (*c*) a circular disc from a piece of board, (*d*) an elliptical disc from a piece of board. Joints: a half-and-half open joint, a half-and-half closed joint with pieces at right angles, the same with pieces at oblique angles (60° and 120°), a frame of four pieces joined with half-and-half closed joints with the projecting ends finished in semi-cylindrical form and the edges chamfered, an open mortise and tenon joint, a double open mortise and tenon joint, a closed mortise and tenon joint with projecting end of tenon rounded, a double closed mortise and tenon joint with projecting ends of tenons rounded, an oblique (45°) mortise and tenon joint, a half dovetailed joint halved together, a dovetailed joint with a single tongue, a half dovetailed mortise and tenon joint with a key, a half-blind dowel-joint, a small door with one panel, two pieces of board dovetailed together, a box dovetailed together (which may be a tool-box with the small door above mentioned for a cover), blind dovetails, a drawer. Completed articles like the following, which were among those made in one school by members of one class: oak tool chest, antique oak table, walnut footstool, cherry card-box, shoe-blacking stool, bob-sled, wall cabinet, centre table, book-shelves, bookcase, mantel-cabinet, music-stand, wash-bench, screen door, chiffonier. Several of these articles required wood-carving as well as joinery, and would therefore be properly placed after the exercises in that branch.

(2) Exercises in wood-carving. These are from the Toledo Manual Training School, and are described and pictured in Woodward's *Manual Training School*, pp. 68-71. Grooving or fluting across the grain; the same with the grain; the same both ways, the design being a series of rectangles, one within another; circular grooving; convex panel with tracery; engraved panel with flowing curves; long panel with engraved tendril; carved square panel; quadrifolium in relief; long panel with carved vine in relief; concave circular ground on square panel with design carved in high relief; carved diagonal panel with design of overlapping leaves sharply undercut.

(3) Exercises in wood-turning. Turning a cylinder, a cone, a stepped cylinder, a double-stepped cylinder, a double cone, cylinders and cones combined, small cylinder between larger ones, convex beads, concave beads, sharp-pointed beads, long curves convex and concave and both combined, tool handles, balusters, table-legs, dumb-bells, base-ball bats, hat-pins, drawer-

knobs, and various other things of like kind; face-plate work, three or four pieces to illustrate the method, rosette, cylindrical, and oval cavities; chuck work, as a hollow-stepped cylinder, rings, and balls; extra pieces, as cups, goblets, saucers, napkin rings, croquet balls, hollow cylindrical or spherical boxes, and similar articles made of hard wood and finely finished.

(4) Exercises in pattern-making and moulding. Exercises in moulding with patterns already made (left over by last year's class), in order to learn the use of a pattern; three prescribed exercise patterns to be made from the pupils' own drawings, figured with the usual allowances for draft, shrinkage, and finish; plaster casts of three patterns; from two to six other patterns (according to time and ability), each being tested either with plaster or with white metal; some of the patterns after being tested by plaster castings taken to an iron foundry, the iron castings there made to be kept for subsequent exercises in the machine-shop.

Articles suggested for casting: a simple grate, a bracket, a crank arm, a hose-nozzle, a straight-joint pipe-coupling, an elbow-joint pipe-coupling, a T-joint pipe-coupling, a globe valve, a pillow block, a pulley, a sheave, a cone-pulley. Also various ornamental or useful articles in zinc or brass.

(5) Exercises in forging. All the more difficult exercises to be forged in cold lead before being forged in hot iron.

A bent ring (round iron); a bent double ring, or figure 8; the end of a rod bent in form of a ring; drawing out and upsetting, as in nails, staples, and bolts; a hasp (tapering, bending, and twisting); angle-irons (flat bend and edge bend); a hook hanger; a bent brace; a fork; a trace-chain cross-bar (upset at middle and punched, ends tapered and bent); fuller piece (flat piece of iron fullered, drawn out at each end, and swaged); round piece of iron upset at middle and squared; a lap weld; a tongue weld; a flat ring or ferule welded; a welded eye; a piece of chain with welded links, ring, hook, and swivel; welded bolt-heads; a twisted open-work handle for fire tools; riveting (the handle riveted to a fire-shovel); two pieces of boiler-plate riveted together; a pair of blacksmith's tongs; a lathe-dog; tempering; forging and tempering a set of machine-shop tools (cold chisel, threading tool, round-nose tool, side tool, parting tool, diamond point and inside tool). Also pieces of ornamental work, as hall lamps, lamp-stands, window-grating, fences, gates, cresting, etc.

(6) Exercises in chipping and filing, accurately to given dimensions. Material, cast-iron.

A square prism or a cube, a rectangular block with chamfered edges, a hexagonal prism, a piece for interior finish of angles, two pieces fitted together with square tongue and groove, the same with dovetail tongue and groove (die block), two pieces halved together in form of a Greek cross, hexagonal bolt heads and nuts, a hexagonal wrench, slot-piece, valve seat, gears, chipping off rivets. Exercises with machine tools: some of the foregoing repeated with planer and shaper and finished with the file; also a plain cylinder, a taper-piece, a right and left handed screw, a finished handle, bolts and nuts, a lathe-dog, a face-plate, a pin and flanged nut, shaft couplings, a compass joint (pair of compasses or calipers), a try-square (for machinists' use), a jack-screw, a bench-screw, taps and dies. The latter part of the third year will be taken for fitting, finishing, and setting up the steam engines, lathes, dynamos, or other pieces of machinery that have been selected for final projects.

These courses of shop-work are recommended as good courses to begin with, being the outcome of considerable experience; but there is no reason why desirable modifications may not be introduced at any time. Indeed there is no school in which the shop-work has been precisely the same from year to year. Small changes regarded as improvements are frequently made, but the main features have not been disturbed.

The accommodations necessary for carrying on the course of study above described consist of school-rooms, drawing-rooms, and workshops, with their appropriate adjuncts. In deciding on the number and size of these, there is one important fact to be kept in mind—namely, that each school-desk, work-bench, and drawing table will be occupied by three different pupils in the course of a day; so that the number of desks, benches, or tables need never exceed one-third of the number of the pupils to be accommodated. In the ordinary school each pupil is allowed the exclusive possession of one desk, which he occupies all day; so that the number of desks must be equal to the number of pupils. But while in the proposed school two-thirds of the usual number of desks may be dispensed with, there will be needed some provision by which each pupil can keep his books safe from being meddled with while not in use. The same need will arise also in the drawing-rooms and workshops;

indeed, in every room, the occupants of which change from time to time during a day or week. This need should be met by providing a system of lockers—one locker for the exclusive use of every occupant of the room.

Two plans for doing this have found favour, which, for the sake of having names, may be called the *key-board plan*, and the *drawer-rack plan.*

By the first, or key-board, plan, each bench, desk, or table has as many locked drawers as it is to have different occupants, so that each occupant may have exclusive use of one drawer. All the keys belonging to the members of one class are kept on the class key-board; and this key-board is inaccessible at all times, except when the class is in the room. The teacher keeps the key-boards safe when not in use, and has as many of them as he has different classes in the room.

By the second, or drawer-rack, plan, each bench, desk, or table is provided with one place in which a drawer may be kept while in use; but while not in use all the drawers are kept in a rack at the side of the room; the intention being that the drawers belonging to any one class shall be removed from the racks and placed in the benches, desks, or tables at the beginning of the class session, and put back again at the end of the session. When the drawers are placed in the rack, the teacher's key with one motion locks or unlocks them all. Thus the teacher's trouble in working the plan is very slight.

The choice between these two plans will be governed by circumstances. For example, when the drawers are large and heavy, as those containing carpenter's tools usually would be, the key-board plan would be the preferable one. But when the drawers are small, so as to be carried across the room without difficulty, the drawer-rack plan would have greater advantages. In school-rooms, since a school-desk with three drawers in it large enough to be serviceable is an impossibility, the drawer-rack plan would be the only practicable one. The same plan has been found an excellent one for the drawing-rooms and the machine-shop; also for the blacksmith's shop, with the further advantage in the latter case that the drawers need not be taken from the racks.

The great merit of these two plans is, that they reduce the number of desks, benches, or tables necessary for a given number of pupils to a minimum. The second, or drawer rack, plan

should be preferred whenever practicable, for it is the most economical plan yet devised for furnishing rooms that are to be occupied successively by different classes.

The next point to be considered is the size of the classes or divisions; for upon the number of pupils to be instructed at one time depends the number of desks, benches, or tables in each room, and the size of the room. The experience of mechanic arts schools thus far seems to have fixed the number twenty-four as the largest number of pupils that can conveniently receive instruction at one time. Although in some book studies more than twenty-four pupils can be well instructed at one time, yet in the shop instruction, as in chemical and physical laboratories, divisions of twenty-four have been found fully large enough—sometimes even too large for really profitable work. The time may indeed come when teaching skill in the mechanic arts will be as highly developed as it now is in the academic branches. When that time comes it may be practicable to make classes in shops and laboratories as large as those in school-rooms; but for the present it would seem unwise to go beyond what experience has shown to be fairly within reach. Twenty-four pupils, then, should be assumed as the basis for determining the number of desks, benches, or tables in a room; and these in their turn will determine the size of the room.

As each room would be occupied in the course of the day by three different divisions of twenty-four pupils each, the total capacity of a room furnished with twenty-four places would be seventy-two pupils. Thus, a class of seventy-two members would need for its whole work one school-room, one shop, and one other room; which other room would be either a drawing-room or a laboratory. Assuming that the school to be provided for would have a course three years long, and therefore three classes—junior, middle, and senior—each with seventy-two pupils in three divisions, or two hundred and sixteen pupils in all, there would be needed three school-rooms, three shops, and three other rooms, or nine rooms in all. These rooms would be occupied all the time, and would constitute the least provision that would meet the conditions of the case. But the number of rooms actually found necessary by reason of the differing kinds of work to be done is somewhat greater—four shops instead of three, and four other rooms (that is, two

drawing-rooms, a chemical and a physical laboratory) instead of three; or, in all, eleven rooms instead of nine. Such would be the provision for a school of two hundred and sixteen pupils. A smaller school could hardly do with less; but a school of double the size would not need to duplicate the whole provision.

The school-rooms, drawing-rooms, chemical and physical laboratories need not be particularly described in this report, since no special modifications in such rooms have been found necessary to adapt them to the wants of a mechanic arts school.

But the shops, being a wholly new feature in school accommodations, need to be described fully. They are—

(1) The first wood-working room, or joinery shop.

(2) The second wood-working room, or pattern-maker's shop.

(3) The first metal-working room, or forging shop and foundry.

(4) The second metal-working room, or machine-shop.

Necessary adjuncts to these are the engine-room, the boiler-room, a store-room for lumber near the wood-working rooms, a moulding-shed near the foundry, and wash-rooms. The best shape and size for all four of the shops would be thirty-six feet wide by forty-eight long. These dimensions are large enough, but two feet more each way would not be space thrown away. The shops should all be high, well lighted (on three sides if possible), by windows running clear to the top. There should be as much window space as possible consistently with due strength in the walls of the building; for abundance of light is a matter of the very highest importance. In planning a new building this consideration would govern all others except the stability of the structure.

Another matter of some importance is the placing of the rooms relatively to one another. Two of the shops are to be furnished with machinery and two are not. By placing the two latter together in one wing a freedom from the troublesome jar of machinery is secured for that wing. Here the drawing-rooms should be placed; for it has been found that drawing-rooms placed over moving machinery are seriously troubled by the vibration.

Again, it is important that the two wood-working rooms should be of easy access the one from the other; and the same advantage is even more important in regard to the two metal-

working rooms. This advantage would be secured by placing the two metal-working rooms in the first storey, and the two wood-working rooms in the second storey. Then by placing the blacksmith's shop under the carpenter's shop, one side of the building would have no machinery. Between the shops on each floor would be placed the wash-rooms, together with the lumber store-room above and the moulding shed below. But further details with regard to the arrangement of a building would seem uncalled for, and may well be postponed until the prospect of an actual building to be arranged becomes immediate. Meanwhile, attention may be directed to the furnishings of the four shops—the benches, the tools, and the machinery—all which would be the same, in whatever building the shops were placed.

(1) The first wood-working room, or joinery shop, should contain twenty-five carpenters' benches—one being for the teacher—and one grindstone.

Within easy reach from both wood-working rooms should be a circular saw and a jig saw. These saws are not for the teachers' use alone; the boys should be taught to use them with care. The benches should be placed with head to the light, and the teacher's bench should have a space behind it where the whole class can gather occasionally to receive instruction. The best dimensions for the benches are six feet long, two feet wide, and thirty, thirty-two, and thirty-four inches high. The different heights are for boys of different stature.

The top of the bench should be a thick hard-wood plank, which may be removed occasionally and given a new smooth surface. Each bench should be provided with a good carpenter's vice—jaws long and on a level with the top of the bench—and with one drawer to hold the tools that belong with the bench. Then there would be needed seventy-two other tool-drawers to contain the tools for which each pupil is held individually responsible. These seventy-two drawers would be placed either in the benches, three in each bench, or in racks at the side of the room, according as the "key-board plan" or the "drawer-rack plan," already described, should be adopted for this shop. Under the key-board plan each bench would have four drawers, one for the bench-tools, which need not be locked, and three for individual tools, which should be kept

locked with keys that are kept on the class key-board. This may be the preferable plan; but if carrying the rather large drawers of tools across the room at the beginning and end of every lesson be not considered a serious objection, there may be an advantage in the drawer-rack plan; for under that plan each bench would have but one drawer—that for the bench-tools—and a place for holding another drawer while its owner was working at the bench. Thus there would be room under the bench for a pair of trestles, and the inconvenience of using lower drawers would be obviated. But the choice between these two plans might turn on circumstances not now foreseen. Either plan would be preferable to the plan hitherto usual, by which the bench-tools are kept on a tool-board attached to the bench, extending nearly its whole length, and rising above its top about two feet. These tool-boards are seriously inconvenient in several ways, and the problem has been how to get rid of them. Either of the plans above suggested is believed to be a satisfactory solution.

As already implied, there is a classification of the tools to be supplied in the carpenter's shop. There are, first, the tools which the pupil needs to have constantly within reach, but which are not likely to be kept in good condition unless some one is held individually responsible for them. These are planes, chisels, and gouges—indeed, all edged tools that are in constant or frequent use. Such tools are issued to each pupil at the beginning of a term, and are kept by him in the drawer provided for his individual use, as above described. They may be called *individual tools.*

Then, secondly, there are tools which the pupil needs to have constantly at hand, but which need no special care to keep them in good condition. These are hammers, mallets, chalk-lines, try-squares, compasses, screw-drivers, etc. They are issued one to each bench, and may be called *bench-tools.* They are kept in the draw provided for them.

Thirdly, there are the tools which are not in constant or frequent use, and which may be kept in the teacher's tool-closet, thence to be issued on check to the several pupils who may need occasionally to borrow them. These may be called *occasional tools.*

Of the occasional tools, one or two of a kind would generally be found a sufficient supply for the whole shop.

Of the bench-tools, there would be needed as many of each kind as there were benches; and of the individual tools, as many as there were pupils.

To provide so large a number of individual tools is somewhat costly, but seems not uncalled for. There has been some experience on this point worth considering. There are schools in which no provision of individual tools is made, the edged tools in most frequent use being supplied only as bench-tools. The economy of such a plan is evident, but the great objection to it is the practical certainty that the edged tools so used will be constantly in bad condition. A boy finding the plane dull will not be disposed to take the utmost pains to put it in perfect order, and leave it so, if he knows that before he will use it again others will use it and leave it dull; but if he can be secured the full benefit of his pains in sharpening his tools, he will be disposed to keep them always in the best of order. This is what we might have expected beforehand, and experience has realised the expectation. Now it is well known that accurate joinery depends on the sharpness of the cutting-tools—good joints cannot be made with dull tools; and it is an observed fact that the quality of the carpenter-work is distinctly better in those schools which provide each pupil with a kit of edged tools for his exclusive use.

The extra outlay required by such provision of individual tools seems fully justified by the better results that are sure to follow. Without this provision it seems hardly practicable to teach the boys that best accomplishment of a good workman, the art of keeping his tools in perfect order.

The following list of tools are given as approximate statements of what may be needed. The third list, consisting of special tools for occasional use, could be extended at moderate cost, as needs might arise.

List of tools for the carpenter's shop:—

(*a*) Individual tools, one for each pupil—jack-plane, jointer (22″), smoothing-plane, block-plane, set of chisels (¼″, ½″, ¾″, 1″, 2″), gouges (¼″, ½″, ¾″, 1″).

(*b*) Bench-tools, one to each bench—cross-cut saw (20″), rip saw (20″), back saw, claw hammer, mallet, try-square, bevel, compasses, marking-gauge, mortise-gauge, two-foot rule, small steel square, nail set, screw-driver, bit-brace, oil-stone, oil-can, bench brush, and pair of trestles.

(*c*) Occasional tools, one, two, or more of a kind as may be needed—hatchets, draw-shaves, spoke-shaves, wood rasps, wood files, compass-saws, bits of all sorts and sizes, monkey-wrench, clamps, pair matching-planes, beading-planes, moulding-planes, rabbeting-planes, plough, fillister, and as many full sets of wood-carving tools as might be needed.

The tool-closet is intended for both wood-working rooms; hence the foregoing list is fuller than would be necessary for one room alone. In the tool-closet should be kept a supply of glue, sand-paper, shellac, stains, varnish, nails, brads, and screws.

The cost of the benches and tools for the first wood-working room, as above described, should not exceed $1500.

(2) The second wood-working room, or pattern-maker's shop. This should be furnished with benches and tools in much the same way as the other shop was furnished, with the important addition, however, of twenty-four wood-turning lathes. In some shops the lathes are attached to the benches, which, for economy of space, are made double; but a better arrangement appears to be to place the lathes by themselves around the edge of the room near the windows, and then to place the benches so that each one may stand near a lathe, thus allowing the boy using both to step readily from one to the other. By this arrangement the boys are not exposed to each other's turning-chips, as they are when the lathes are attached to the double benches.

If the room be well lighted, the benches may be placed far enough away from the windows to allow the lathes to be placed as proposed. The benches in this room are in all respects like those in the carpenter's shop, except that the vices are of the variety known as coach-makers' vices, the jaws of which are some six or eight inches above the top of the bench.

The tools to be supplied to this shop are substantially the same as those supplied to the carpenter's shop, with the addition to the individual tools of a few tools for turning. The turning-tools should be two turning-gouges (¼", ⅞"), two turning-chisels (⅜", ⅞"), one parting-tool, one round-nose tool, and one pair of calipers (5"). Any other tools that may be needed may be added to the occasional tools already provided in the carpenter's shop, the chest containing them being accessible from this shop as well as from the other.

The cost of furnishing the pattern-maker's shop in the manner described should not exceed $2000.

(3) The first metal-working room, or forging shop. This shop will necessarily be placed on the ground, for it should have no wooden floor; and the anvils should be mounted on posts running down some four feet into the ground. Twenty-four anvils, twelve double forges, a teacher's anvil and forge, hoods over the forges, smoke-pipes, and an exhaust fan to draw out the smoke, are the furnishings required for the principal business of this room. If metals of any kind are used for casting, the melting-furnace should be placed in this shop, and the casting should be done here. The moulding-trays are stored, when not in use, in some adjoining room or shed; but when in use some of them may be placed temporarily in this shop. Hence the whole provision for moulding and casting may be considered as belonging to the first metal-working room; in other words, this room is a foundry as well as a blacksmithy. As already stated, the use of iron for casting is not contemplated.

The tools needed for forging are all of the kind named bench-tools; that is, all the occupants of one forge use the same kit of tools. There is no reason for providing individual tools.

The tools at each forge are one anvil (84 lbs.), blacksmith's hammer (1½ lbs.), four pairs tongs (¼", ⅜", ½", ¾"), a poker, a rake, a shovel, a sprinkler, a hardy, a steel square, and a leather apron. One sledge to two forges. Occasional tools, as cold chisels, punches, etc., are not numerous. Moulding-trays should be 4½ feet long by 1½ feet wide and 1 foot deep, the top being about 30 inches from the floor. Over one end of the tray should be placed a movable board 1½ feet square. The backs of the trays may come up high enough to hang the tools on, provided they do not obstruct the light; but if they do, they should be dispensed with.

The tools needed for moulding are a small shovel, a 12-inch brass-wire sieve (⅛" mesh), a moulder's trowel (1" × 4"), a ¼-inch lifter, a draw-spike (6" long, ¼" diameter), a larger draw-spike (8" × ⅜"), a vent wire, two rammers (1½" and 3" diameter), a dredging-box, several conical wooden plugs, a straight-edge, a small sponge, and a small square piece of tin bent to form a gate-cutter. Most of the moulder's tools can be made by the boys, and so may some of the forging tools. The

making of a pair of tongs, for example, is an excellent exercise in forging, and the product is usually worth keeping for use. The turning of wooden tool handles is a good exercise towards the end of the first year in school. The second year's work includes the making of a number of tools that will be used in the blacksmith's or the machine shop.

For the forges, anvils, moulding-trays, blacksmith's and moulder's tools, a safe estimate is $1200. For the smoke-pipes, exhaust fan, and power-blast necessary for ventilating the room and blowing the fires, no close estimate can be made until the conditions of the actual room to be ventilated are known. But allowing $1300 for this, the total estimate for this room will be $2500.

(4) The second metal-working room, or machine-shop. This shop is furnished with a machinist's bench around the outside of the room, and with machinery filling the rest of the floor space. On the bench are twenty-four machinists' vices, and underneath are drawers for the bench-tools and places for other drawers, which are kept in a drawer-rack. These drawers are not large, and so the drawer-rack plan will be convenient for the machine-shop. The bench on one side of the room should be lower than that on the other, and the shorter boys should be placed at the lower bench.

The machinery should consist of twelve engine-lathes (some larger, others smaller), four speed-lathes, one planer, one shaper, one goose-neck drill, one post-drill, two emery grinders, and a gas forge. The *bench tools* consist of a machinist's hammer, a pair of compasses, a pair of calipers, a measuring scale, and a set of files. The *individual tools* are the tools made by the pupils the preceding year for use in the machine-shop. They are cold chisels, centre punch, centre chisel, threading tool, round-nose tool, side tool, parting tool, diamond-point tool, inside tool. These were forged and tempered last year. This year they are to be ground to the proper shapes and kept in good condition under the teacher's directions. The *occasional tools* to be issued on check are not numerous, and may be supplied as needs arise.

The cost of the machinery will vary widely according to the different patterns and sizes and with different makers; but with any machinery at all suited to the purposes in view the expense of furnishing the machine-shop will be large. The opinion of

those who have had experience is that small and cheap machines are not worth buying. Solid machines of the best construction are needed to stand the wear and tear of school-shop use. Indeed, the same remark applies to all the machinery and all the tools throughout the shops. They should all be the best of their kind. Inferior tools are not easily kept in good order, and inferior work is the result. It is not safe to estimate the expense of tools and machinery in the machine-shop at less than $6000.

Estimates for the wash-rooms would depend so much on the plan and style of plumbing adopted and on local circumstances that they may here be omitted. Caps, aprons, blouses, overalls, soap, and towels should be kept in the individual drawers in the two wood-working rooms, for there the drawers are large enough to hold these things; but in the forging-shop, and possibly in the machine-shop, pigeon-holes should be provided for the purpose. In these pigeon-holes, or in the individual drawers, as the case may be, are to be kept any unfinished pieces of work the teachers may prefer to have cared for by the pupils themselves.

Such are the four shops with their furnishings and the tools. These shops are not fully occupied all the time, for there are four shops and only three classes. But it does not appear to be practicable to carry on the proposed work in fewer shops. To explain briefly how the shops would be occupied, let the school year be divided into three equal terms, say of thirteen weeks each. A class in passing through the School in three years would spend the nine terms as follows: the first and second in the wood-working shop, the third and fourth in the pattern-maker's shop, the fifth and sixth in the forging shop, and the seventh, eighth, and ninth in the machine-shop. Thus, apparently, the wood-working shop would be vacant in the third term of the year, the pattern-shop vacant the second term, and the forging-shop the first term. But these shops would not be wholly unoccupied in the terms mentioned, for the boys in the pattern-shop during the first term of the year would use the forging-shop to some extent for moulding and casting, and boys in the machine-shop during the second term of the year will need to use the pattern-shop to some extent in making patterns for their projects, or during the third term of the year might need occasionally to use benches in the wood-working shop.

Thus the provision of four workshops for three classes appears to give no more than a reasonable margin for convenience in working.

As regards organising the school, it may be assumed that the full school of three classes would not be in operation until the beginning of the third year, and the full equipment of tools and machinery would not be needed until that time; but, on the other hand, it will be necessary to order the machinery six months or a year in advance of the time when it will go into use.

At the start the school would need to have ready one school-room, one drawing-room, and the *second* wood-working room with its benches, lathes, and tools. This would provide for the shop-work for one full year, and some weeks of the second year, assuming, as already explained, that the entering class would not exceed seventy-two in number.

At the beginning of the second year the *first* wood-working room should be ready; and then, or very soon afterwards, the forging-shop; both with their outfit of tools, including also trays and tools for moulding and the melting furnace. Another school-room would also be needed at this time.

At the beginning of the third year the machine-shop should be ready; also another school-room and a second drawing-room. Thus the full school of two hundred and sixteen boys would be provided with rooms, except in the matter of chemical and physical laboratories. If foreign language should take the place of these sciences in the course of study—which has been left an open question—then these laboratories would not be needed. It is also possible that one of the drawing-rooms might be large enough to accommodate the work in physics. Therefore the provision of the chemical and physical laboratories may be left an open question for the present.

Respecting the appointment of teachers, it may not be out of place to remark on a few points of prime importance. The principal of the school should be a man in thorough sympathy with the kind of work the school is to do. If he should have some practical knowledge of shop-work himself, so much the better. He should be a man of full academic training, a man of experience, and accustomed to the management of large schools. He should have supervision and control over the entire school in all its branches of work. His rank and salary should be equal to those of other high school principals of the city.

After the selection of the right man for principal, the next most difficult matter will be the finding of entirely suitable persons to be assistants in the different branches of shop-work. To find a good carpenter, a good blacksmith, or a good machinist is comparatively an easy matter. But this is not enough. The men selected must possess the faculty of imparting their knowledge to classes. They must possess the essential qualifications of a good teacher—must know not only the art they would teach, but the art of teaching. Sometimes it happens that a practical mechanic has had in his youth a thorough academic and even a collegiate education. If such a person could be found who also had the gift of teaching, his combination of qualifications would be the best. The discovery of such persons may appear difficult, but it is not a hopeless task; in proof of which might be named a college graduate, who, after taking his degree, passed seven years in a machine-shop, and is now a highly successful teacher in a mechanic arts school. Still it must be recognised that the happy combination of all the desirable qualifications is rare, and cannot reasonably be insisted on.

What ought, however, to be insisted on as absolutely essential, is that any assistant teacher, in whatever capacity employed, should have the habit of using the English language clearly and correctly. Too much emphasis cannot be laid on the importance of taking care lest the introduction of sewing, of cooking, or of manual training in any form into the schools become a source of injury to them through the appointment of persons to teach these things whose instruction would be conveyed in ill-chosen or incorrect language.

Of course it needs no pointing out that the moral character and personal habits of any person appointed to teach anything should be wholly unexceptionable.

E. P. S.

CLOSING NOTE.—The reader of the above "plan" will demand no apology from me for inserting it unless it be to give me an opportunity to say that I use it with Mr. Seaver's full consent. The "plan"

ought to be, and probably is, better than that of any existing school. The judicial position occupied by its author enabled him to select the best features of all schools. The friends of the St. Louis school are abundantly gratified that he has so generally approved its plan.

C. M. W.

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